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*of the*

## American Physical Education Association

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# The Apparent Importance of Arm Strength in Athletics

By C. H. McCloy
*State University of Iowa*

THE INTERCOLLEGIATE Strength Test*[1] was introduced into the eastern colleges about 1880 and was used in many institutions for the purpose of determining whether or not a student was fit for participation in the major sports.† This test consisted of the strengths of the right and left grip, the back lift, the leg lift, blowing against the pressure of something resembling a steam gauge, and chinning and dipping. The chinning and dipping were scored by multiplying the number of chins and dips combined by one-tenth of the man's weight. The total of all of these items was taken to be the total strength. This test was used for competition but because of the fact that the test results were not used for anything very constructive, it was largely dropped from the testing program about 1900.

In 1925, Rogers[2] presented a revised form of the Intercollegiate Strength Test in which the expiratory blowing pressure was replaced by the lung capacity, and the chinning and dipping were scored by a slightly different formula.

$$\left(\text{Chins} + \text{Dips}\right)\left(\frac{\text{Weight}}{10} + \text{Height} - 60\right)$$

This Physical Capacity Test, as Rogers called it, was thoroughly investigated by its author and has been pushed with both zeal and imagination so that today the individual records for the Strength Index and the Physical Fitness Index are widely used, and in many places are used for purposes only remotely related to a test for strength.

In 1931 the author proposed a method[3] of scoring chinning and dipping strength that was more accurate than that used either in the Intercollegiate Test or in Rogers' test, and he subsequently combined this method of scoring with the other elements of Rogers' test and undertook further experimentation in this field. This paper will report a few of the most striking of these results.

## TWO USES OF STRENGTH TESTS

It should be pointed out that there are at least two fundamentally different uses for tests of strength. The first is that of using these tests as

*Numbers refer to bibliography at end of article.

†A paper presented before the Research Section at the American Physical Education Association Convention, April, 1933, at Louisville, Kentucky.

indices of health or of general physical condition. Dr. D. A. Sargent in 1913[4] pointed out that the test of strength lent itself admirably to this purpose, and Rogers has strongly emphasized this use in recent years.[2] Chamberlain and Smiley[5] have presented striking evidence of the validity of the Physical Fitness Index of Rogers as a rough measure of health. For this first purpose the strength tests should probably be *unweighted,* as is the case in the Rogers' test, though in the opinion of the author it is a question whether the norms should not be determined from age and *normal* weight rather than for age and *actual* weight. If the norms were determined from normal weight, then actual weight should be one of the variables in the formula for the strength index. Using the strength test for this purpose of measuring health, lung capacity is probably advantageous and should be retained; and for this purpose Rogers' Strength Index interpreted in the form of the Physical Fitness Index is admirably adapted, though in the opinion of the writer it would be more valid if the arm strength were differently computed.

The second use of strength tests is that of predicting either potential general motor ability or potential general athletic ability. Within the scope of this second use of the tests would come that of classifying pupils for physical education groups. For this use it is by no means certain on any *a priori* grounds that lung capacity should be included or that the tests should be equally weighted. *The studies reported here are concerned wholly with this second use for strength tests.*

## THE METHOD OF STUDY

In all, the end results of eight different studies are reported here. The results agree so closely as to make it unnecessary to present all of these studies in detail. The method used in each study was roughly the same. A criterion was established. The elements of the Rogers' Strength Test were given to the pupils and then the various elements of the test were correlated separately with the criterion, and each element was correlated against each other element. A multiple regression equation, together with the multiple correlation, was then computed for predicting the criterion variable.

The criterion in two cases was a battery of test elements devised to measure general motor ability. These were composed of some track and field tests, tests involving strength such as throwing the medicine ball for distance, tests involving agility such as obstacle races, and the like.

In three cases the criterion was composed of a battery of track and field events, each scored on a scoring table, and the sum of the points used for the criterion. In one case the *force* required for the Sargent Jump was computed by an appropriate formula and used as the criterion.

In one case the criterion was composed of a rating of football ability in high school students; this rating was properly validated and had a sufficiently high degree of reliability.[6]

In the last study the criterion was based on a classification of pupils for gymnasium classes. This classification was purely a subjective one based upon the judgment of the instructors.[7]

In two preliminary studies, lung capacity and weight were investigated to determine whether or not they should be included as elements in the test. In the first of these studies three combinations were tried.

1. The Rogers' test given and scored as recommended by Rogers.
2. The best weighting of the Rogers' battery, with the chinning and dipping strength scored by the author's formula. Lung capacity was included.
3. As in (2) but without lung capacity. This study was conducted on a group of 300 senior high school boys; the criterion variable was total points in four track and field events. The correlations obtained with each of the three combinations listed above and the criterion variable were as follows:

(1) Rogers' Test (unweighted), $r = .6403$
(2) All Rogers' events *weighted,* with lung capacity, $r = .7224$
(3) All events *weighted,* without lung capacity, $r = .7193$

Aside from the fact that the *weighting* of the events increased the correlation markedly over that obtained with the Rogers' battery, the outstanding conclusion is that the addition of lung capacity is of little significance for this particular problem, hence lung capacity may be omitted, and has been omitted, from the remainder of the studies which are here presented.

In the second phase of the preliminary study, weight was tried as one of the test elements. The results (without lung capacity) were as follows:

1. Best weighting of strength elements without weight, $r = .7193$.
2. Best weighting of strength elements with weight, $r = .7770$.

It will be noticed here that weight is apparently an important variable and it is worthy of notice also that weight is always *subtracted* in the formula, not added. The relative weightings will be given below.

## THE STUDIES REPORTED

The main studies to which those reported above were preliminary, may be divided into five groups.

*Group I.*—The correlation of the *force* used in the Sargent Jump with strength.[8] The force was computed by the following formula:

$$Fd = \tfrac{1}{2}MV + Mgd$$
Since $V^2 = 2gh$, then
$$Fd = Mgh + Mgd$$
$$Fd = Mg\ (h + d)$$
Therefore $$F = \frac{Mg\ (h + d)}{d}$$

In this formula $d$ = the distance over which force is applied; the other factors, $h$ (height of jump), $M$ (mass of the individual), and $g$ (gravity) were known.

In this case the regression coefficients were not computed but the partial and multiple correlation coefficients were as follows:

$r_{fl.ba} = -.124 \pm .08$ $\quad R_{f.bla} = .828$
$r_{fb.la} = -.173 \pm .08$ $\quad r_{fa} = .808$
$r_{fa.bl} = .703 \pm .04$

In these formulae the meaning of the subscripts is as follows: $f =$ force; $a =$ arm strength, which was composed of chinning and dipping strength added; $b =$ back lift; $l =$ leg lift.

It will be seen in the partial correlations above that back lift and leg lift give a relatively small and insignificant partial correlation, while arm strength gives a large partial correlation even with back and leg strength held constant. It will be further seen that in the zero order correlation, arm strength gives almost as high a correlation as does the total strength. It is therefore apparent in this study that arm strength is the most important strength element in this jump.

*Group II.*—The second phase of the study was made with the criterion of general motor ability measured as described above. In the first of these studies[9] the multiple correlation of the whole weighted test of Rogers' test elements, plus weight but without lung capacity, was .6775. The shortened test, with only grips, chins, dips, and weight gave a multiple correlation of .6598, which was slightly higher than with the weighted complete test without weight (.6227).

In the second of these studies,[10] the multiple correlation of the whole battery was .5528, and without the back and leg lift, .5420.

The multiple regression formulae, in a somewhat simplified form, are given below. These are all equated to twice the chinning strength.

(1)[9] $.6G + .25B + .05L + 2C + .7D - 4W$
(2)[10] $2.3G + .17B + .25L + 2C + 1.9D - 4.8W$

In these and all subsequent formulae the code is as follows: $G =$ grips; $B =$ back lift; $L =$ leg lift; $C =$ chins; $D =$ dips; and $W =$ weight.

These when combined or averaged give the following formula:

$1.5G + .2B + .15L + 2C + 1.3D - 4.4W$

A perusal of this formula will make clear the large emphasis given to the strength of the arms, as is seen in the tests of grip, chinning strength, and dipping strength. As will be seen later, however, in these tests of general motor ability the back and leg strength assume a little more importance than is the case with the track tests.

*Group III.*—In this third group of tests the criterion was composed of from four to six track and field events. The three regression equations obtained are as follows:

(1)[11] $.9G - .4B + .01L + 2C + 1.1D - 2W$
(2)[12] $.34G - .07B + .008L + 2C + .8D - 1.8W$
(3)[13] $3.2G + .17B + .29L + 2C + 3.2D - 4.4W$

When averaged these three give the following equation:

$$1.5G - .1B + .1L + 2C + 1.8D - 2.7W$$

The author believes that the minus equation in the back lift is probably a sampling error and indicates merely that back strength is not highly important as a predictive factor.

In these studies the multiple correlations were as follows:

| | | |
|---|---|---|
| 1. | With all test elements plus weight; | $R = .9142$ |
| | Without back and leg lifts; | $R = .9106$ |

The high correlations in this study are due to two factors: first, the range ran from the fourth grade through high school; and second, the group had been in athletic training for three months.

| | | |
|---|---|---|
| 2.[12] | With all test elements plus weight, | $R = .7352$ |
| | Without back and leg lifts, | $R = .7352$ |
| 3.[13] | With all test elements plus weight, | $R = .5680$ |
| | Without back and leg lifts, | $R = .5686$ |

Again it is seen that the test without the back and leg lifts gives practically as high correlations as the whole test.

*Group IV.*—The fourth test is that of the football ratings.[6] The multiple regression was as follows:

$$1.3G + 2B + .5L + 2C + 8.3D - 8W$$

The multiple correlation for all test elements plus weight was:

| | |
|---|---|
| | $R = .5467$ |
| Without back and leg lifts, | $R = .4762$ |

In this case (football) back and leg strength is of much greater importance.

*Group V.*—The fifth test was that in which the estimated homogeneous classification was used as the criterion.[7] In this the multiple regression was as follows:

$$.67G + .2B + .2L + 2C + 3D - 7W$$

The multiple correlation:

| | |
|---|---|
| With all tests elements plus weight, | $R = .8842$ |
| Without back and leg lifts, | $R = .8750$ |

In all of the cases listed above except football, back and leg strength seemed to be of relatively little importance for predicting either general motor ability, track and field athletic ability, or classification. When omitted, the multiple correlation is reduced very little indeed. In one of the studies on motor ability an additional element was used.[10] This was the strength of the thigh flexors. The Martin Spring Dynamometer[14] was used for this measurement. The individual measured lay on his back on a table which was held to the floor. He clasped the end of the table behind his head and flexed thighs and legs to a right angle. The strap of the

dynamometer was slipped over the knees about one inch above the patella. The tester then pulled in a direction away from the head as hard as was necessary to force the individual's thighs to give way or to "break." This "breaking strength" was taken as the strength of the thigh flexors. The addition of this element raised the multiple correlation with all events and weight from .5528 to .5766, and without the back and leg lifts, it was raised from .5420 to .5713. In this latter case the improvement in predictability is one of 12 per cent. This element of thigh flexor strength seems to be of greater importance in predicting general motor ability than are the back and leg strength.

Our final combinations of these tests ranging from the most complete to the less complete, and representing a general compromise between the average formulae for general motor ability and those for athletic ability are as follows:

1. $1G + .1B + .1L + 2C + 1D + 3$ (Thigh Flexors) $- 3W$
2. $1G + .1B + .1L + 2C + 1D - 3W$
3. $1G + 2C + 1D + 3$ (Thigh Flexors) $- 3W$
4. $1G + 2C + 1D - 3W$

These tests would be somewhat improved if the grip and dip strength weightings were 1.5. This would, however, somewhat complicate the computation and the resulting correlations are not sufficiently raised to justify the additional labor.

To check these results, two other forms of multiple correlation were computed. The subscripts may be read as follows: 0 = the criterion; 1 = grip strength; 2 = chinning strength; 3 = dipping strength; 4 = back lift; 5 = leg lift. $R_{0\cdot123\text{-}45}$ may be read as "the correlation between the criterion variable and the best combination of variables 1, 2, and 3 with 4 and 5 held constant." While $R_{0\cdot45\text{-}123}$ may be read as "the correlation between the best combination of 4 and 5 with the criterion with 1, 2, and 3 held constant." The results were as follows:

| | $R_{0\cdot123\text{-}45}$ | $R_{0\cdot45\text{-}123}$ |
|---|---|---|
| $(1)^{12}$ | .569 | .087 |
| $(2)^{18}$ | .391 | .110 |
| $(3)^{9}$ | .372 | .217 |

These results would seem to confirm the relative importance assigned to arm strength.

It will be noted above that in the football study the back strength, leg strength, and dipping strength were much more important. The place of strength tests as predictors of ability in specific sports needs further study.

## EXPLANATIONS OF THE APPARENT IMPORTANCE OF ARM STRENGTH

When one considers the results tabulated above, the question arises, why does arm strength seem to be so important in the prediction of either general motor ability or track and field ability, and why does back and leg

strength seem to be of lesser importance? The following possible explanations occur to the writer.

1. In a relatively large proportion of a high school population of boys the back and legs are probably fairly well developed to the standard of the weight of the body. Every boy has to carry himself around, and if he engages in the usual athletic program his legs and trunk will inevitably develop to the point of being able to carry his body weight effectively.

2. In case the arms are well developed as to strength, the back and legs are usually also well developed. The individual develops his arms doing activities which use the other muscle groups. The reverse, however, is not necessarily true; for individuals who engage in running or jumping programs develop the trunk and legs but do not necessarily develop the arms. The correlation between chinning strength alone and all of the rest of the body in the one study[10] in which this comparison was made was .91.

3. A mechanical explanation of the importance of arm and shoulder girdle strength to general motor ability or athletics falls into four steps:

a. In many of the activities involved in general motor ability items, and in the shot-putting activities in track and field, arm strength is of course needed.

b. It should be remembered that arm strength in that case is not only strength of the arms themselves but also strength of the pectoral muscles, the serratus anterior, the latissimus dorsi, and the deltoid. Hence the strength involved is also strength of muscles that *swing* the arms as well as strength of arms alone.

c. In a very large proportion of vigorous activities the arm movements have an action-reaction relationship to performance that is quite important. Let us illustrate in two ways. First in the standing broad jump. As the individual jumps forward the arms are swung vigorously forward and upward, the individual leaving the ground at an angle of 45°. Just after the feet leave the ground the arms are swung vigorously downward and backward. This downward and backward *action* of the arms is of course accomplished with a forward and upward *reaction* of the body which adds very largely to the distance jumped. This principle applies in all standing jumps and to a somewhat lesser extent in the running jumps.

If one considers running, the same principle holds true but with a different application. As the left leg goes forward and the right leg backward, if the arms were held rigidly at the sides this forward and backward action of the legs would be accompanied by an *opposite* reaction of the hips and trunk so that as the left leg went forward the right foot would go backward and the two femurs would cross about four inches below their heads. This would of course shorten the stride. This circular reaction is counteracted by the antagonistic swing of the arms. Thus as the left leg goes *forward* the left arm goes *backward* and the right arm *forward;* if this arm swing is sufficiently vigorous, it completely counteracts this rotary effect of the legs, lengthening the stride.

d. It is obvious that this arm motion works in two ways. In the first place *strong* arms, because they have more muscular tissue, are *heavier* arms, hence are capable of greater reaction. Second, since they are stronger they can be swung both harder and faster, again increasing this reaction.

Owing to these reasons listed above the author believes that the results obtained in this study which seem to indicate that strong arms and shoulder girdles are of even greater importance than back and leg strength for general motor performance, do not misrepresent the facts.

## IMPLICATIONS FOR PROGRAM

It would seem to the writer that programs of physical education that emphasize running, jumping, and the throwing of light balls as the sole racial activities, are deficient programs. It should be remembered that hanging, mounting, and climbing with the hands and arms, as well as the throwing of *heavy* weights and the lifting, pushing, and pulling of others also constitute very important forms of racial activities—forms that probably antedated the running and jumping forms in human phylogenetic history! Hence it would seem wise to provide a place in the program for a certain proportion of arm and shoulder girdle activities of a relatively strenuous type (and, parenthetically, some exercises which strengthen the abdominal and thigh-flexor muscles as well) not only for their general strengthening effects but for their transfer values to almost *all* motor activities.

This should not be interpreted to mean that the writer advocates a return to the biologically sterile type of formal programs of the past—the modern program of physical education is too rich in teaching material to demand that—but it does imply that the writer believes that a radical change is needed in nine-tenths of the programs in common use today. It is believed that the development of the strength of the upper limbs would improve the performance of any type of athlete, and that in justice to the pupil—from the standpoint of promoting more skillful performance and with it greater interest and pleasure in participation—such development should be assured fairly early in his school life.

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# A Study of the Use of Percussion Instruments as Accompaniment in the Dance

By Harriett K. Graham
*New York City*

## INTRODUCTION

UP TO this time there has been very little written concerning the use of percussion instruments in the dance. Many people have noted the need for the use of percussions in the dance, and some few have recognized the many possibilities inherent in them. But few people have studied these instruments to discover their unique values, their limits, their principles of use, and the ways of playing them as accompaniment for the new dance. There have been many who have beaten out rhythms on the drums indiscriminately, while overlooking their true purpose.

Probably the greatest amount of work upon this subject has been done by the Wigman School. Miss Mary Wigman was a pupil of Von Laban, who was the first of the moderns to try freeing the dance from music, for he started with movement rather than music as the basis of the dance. With this latter aim in view, it was only logical that the Wigman followers should try to discover some accompaniment that would enhance the meaning of the dance, rather than to adhere to the old method of evolving the dance patterns out of the music itself. In accompaniment by percussion instruments they discovered what they had been looking for.

In spite of the fact that the Wigman School has worked a great deal with percussion accompaniment, members of the group have written nothing on this work. For this reason, their influence is somewhat restricted, and others who seek light on the subject can learn only through direct contact with the school or its students, or by personal experimentation. This paper is, then, an attempt to bridge this gap of information by gathering together the opinions of various experts in the field as to how percussion instruments should be used in the dance.

## RACIAL USE OF PERCUSSION INSTRUMENTS

There is some question as to just which were the first musical instruments that man used. There are some who hold that reed pipes were first used, while others believe that percussion instruments were first employed.

Man had his two feet with which he could pound or stamp upon the ground. With this primitive facility, and with the instinctive desire to express the rhythms that were in him, he developed dancing and music. Bauer and Peyser[1] say: "The first step toward a musical instrument was the striking together of two pieces of wood or stone in repeated beats. The next step was the stretching of the skin of an animal over a hollowed-out stone or tree trunk, forming the first drum. Another simple and very useful instrument was made from a gourd (the dried hollow rind of a melon-like fruit) filled with pebbles and shaken like a baby's rattle."

Percussion instruments have been used by every country in the world. "No tribe of savages has been discovered that does not have a drum of some kind. Stefansson, the arctic explorer, has said that the drum is the only musical instrument used by the Eskimos, and there are tribes in other climates also that have no other kind."[2] Different tribes have developed various kinds of drums. Some are made of hollow tree trunks, closed at both ends, with a slit in the top to let the tone emerge; the drum, called a "*lali*," is laid on the ground and the tone is produced by beating upon the wood. In the South Sea Islands the natives have "drum groves"; the drums, made of hollowed-out trunks of trees, tapering at the upper end and having the tops and bottoms closed, are stood up in a vertical positions and look very much like a grove of tree trunks. According to Mrs. Coleman,[3] these drums are sometimes seven feet high and weigh about six hundred pounds each.

Primitive man worshipped his drum, and believed that inside it lived a god whose voice was heard in the tone produced by striking the drum. So early man had uses for his drums other than as mere accompanying instruments for the dance. Drums were used to frighten the enemy, to inspire bravery in the warriors, to heal the sick, to cast out evil spirits, and to express all kinds of feelings. The Africans are famous for their telegraph drums, by means of which they can send code messages to far-distant tribes. They also have talking drums with which they can make sounds "that are actually like the sounds of the native language."[4] These have to be made in a special way, with a great deal of ceremony, and only the chief is allowed to own such a drum. Other primitive uses include calling people together for war or council, keeping the spirits of the dead from returning and haunting the living, and singing to absent loved ones. Primitive peoples believed that the magic of the drum would carry their voices to the person they were addressing, no matter how far away he happened to be.

The American Indian has a song and dance for everything. These

[1] N. Bauer, and E. Peyser, *How Music Grew*, p. 5. New York: G. P. Putnam's Sons, 1925.
[2] Satis N. Coleman. *The Drum Book*, p. 3. New York: John Day, 1931.
[3] Ibid., p. 6.
[4] Ibid., p. 32.

LARGER DRUMS

Two-toned African Drum

African Talking Drums

A "Drum-grove" in the South Sea Islands

dances, with their accompaniment of voice, drums, and rattles, seem like meaningless gyrations to us, but to the Indian they have a very definite pattern and meaning. They have been handed down from generation to generation, and are very carefully reproduced every time they are given. Nothing is changed or left out, since they are ritualistic and every movement and rhythm has a meaning all its own. If anything is changed, it is a bad omen. For instance, the Indian believes that he cannot just burst out into song at any particular time, as we sing our popular songs when the spirit moves us, but he believes that he must sing it only at the appropriate time and in the proper surroundings. The story is told by Bauer and Peyser[5] about an American visitor, making a collection of Indian songs, who asked an old Indian to sing him one of the Indian hunting songs. The old Indian looked at him in surprise and went away. Later the visitor found out that the Indian could not sing him this song because it was not the hunting season. The next time the Indian came to visit him, the American asked him to sing a love song, but the Indian refused, saying that it was not fitting for an old man like himself to sing love songs. However, he finally decided that, since he was making a visit, he could sing visiting songs, and he did. The same attitude applies to Indian dances. War dances are performed only before going into battle, and hunting dances are used only before engaging in a hunt. These dances must be carried out accurately to the most minor detail, or otherwise the battle or the hunt will not be successful. Salomon[6] says: "Only in dances where personal experiences were portrayed was a dancer allowed freedom of invention, and even then he was compelled to follow conventional forms or his story would not be understood."

The Indians use three types of percussion instruments: the tom-tom, rattle, and the notched stick. The rattles are made of gourds, tortoise shells, horns, elm bark, and rawhide with pebbles inside. The notched stick is played by rubbing another stick over the notch.

But dearest to the Indian is his tom-tom. He seldom will sell it, though he will give it away as a symbol of friendship. According to Salomon,[7] "There are three main types of drums; the single- or double-headed hand drum, the large dance drum played by several men, and the water drum used mainly by the woodland tribes." Sometimes clay pots and baskets were used as frames, but generally the frame was made of wood. Since the advent of the white man, the Indian has used cheese boxes for frames. The double-headed drums were generally twice as long as the diameter of their heads.[8] A water drum was made by hollowing out a basswood log and plugging one end of it with water-tight material. A small hole with a

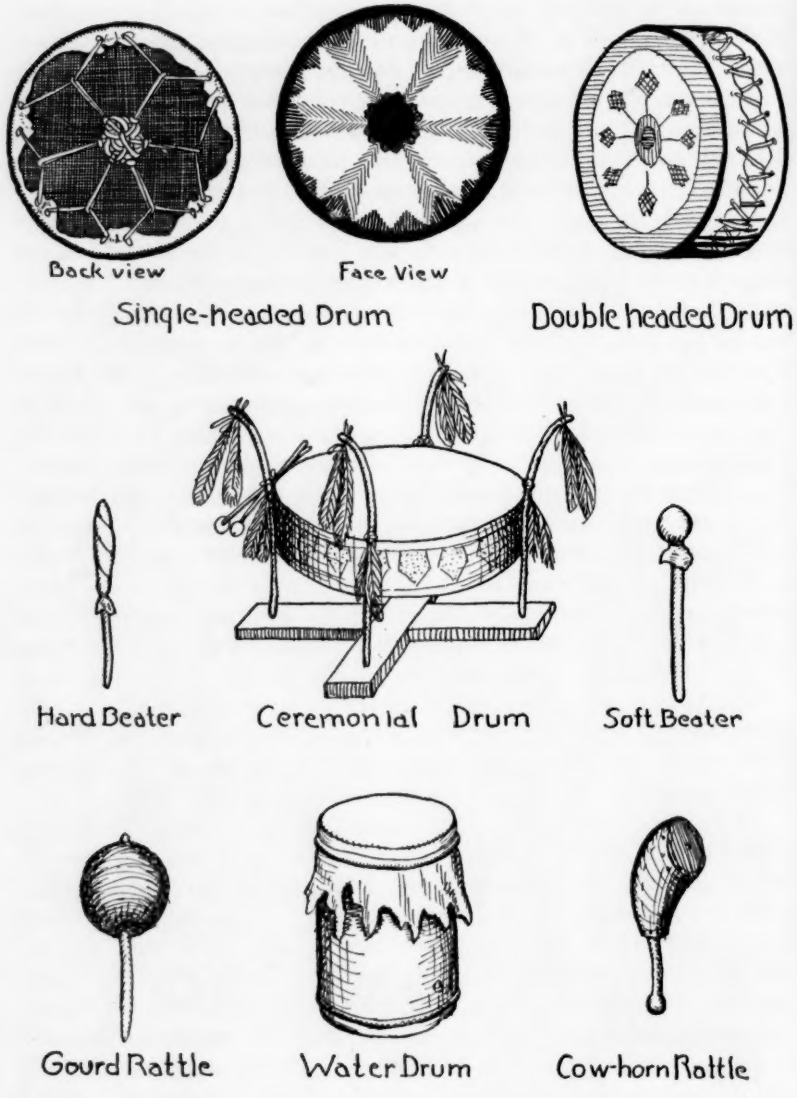
[5] N. Bauer, and E. Peyser, *Op. Cit.*

[6] J. H. Salomon, *The Book of Indian Crafts and Indian Lore*, p. 285. New York and London: Harper and Brothers, 1928.

[7] Ibid., p. 285.

[8] Ibid.

SOME AMERICAN INDIAN PERCUSSION INSTRUMENTS



stopper was made in the side so that water could be poured in. The head was detachable and was held in place by a wooden hoop.The drum was generally filled one-third full of water, and the tone could be changed by splashing the water against the drum head. This drum has the most resonant and pleasing tone of all. Sometimes stands were made for the large drums; these were highly decorated with feathers.

The Indians say that, before going away, one should ask one's tom-tom about the weather. The drum heads are sensitive to changes in weather conditions and will give a lower tone in damp weather. The Indians also say that it is bad luck to hit the tom-tom twice in the same place, and for this reason they use a sort of rolling action of the wrist in playing.

The rhythms used by the Indians sound complicated to our ears, and they are difficult for us to write down, since our own rhythms are so different. Bauer and Peyser[9] say: "Another thing which makes it hard to set down and to imitate Indian music, is that they beat the drum in different time from the song which they sing. They seldom strike the drum and sing a tone at the same time. In fact the drum and the voice seem to race with each other. At the beginning of a song, for example, the drum beat is slower than the voice. Gradually the drum catches up with the voice and for a few measures they run along together. The drum gains and wins the race, because it is played faster than the voice sings. The curious part of it is, that this is not an accident, but every time they sing the same song, the race is run the same way."

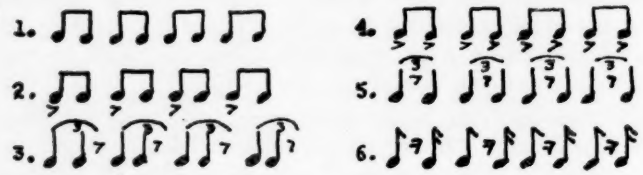
From my own limited experience, I have found that the Flathead Indians of Montana use, for some of the men's dances, a 2/4 time with a strong accent on the first beat. For the women's dances they use a 4/4 time with a strong accent on the first beat and a softer one on the third beat. For this rhythm the women stand in a circle shoulder to shoulder and take short side steps, bouncing and stepping on one foot for the first two beats and on the other for the next two beats. The rest of the body is relaxed, and they keep continually moving around in a circle, with no expression whatever on their faces.

The drum beat for the war dance is a very distinctive 2/4 time. The stick used in hitting the drum does not have a round head, but is merely wound with a piece of cloth on the end. This stick is then held tightly in the hand, and, instead of being allowed to bounce off the drum after the impact, it is held in contact with the drum surface, so that the resultant tone is "squashed." This gives a peculiar rasping sound, which is quite expressive of fury and hate.

In the report of the Bureau of American Ethnology Bulletin 53, *Chip-*

[9] N. Bauer, and E. Peyser, *Op. Cit.*

*pewa Music No. II*, by Frances Densmore, there are 340 songs. In all of these, I have found that there are but 6 drum beat patterns, listed below:



From the same source, page 29, come the following tables:

| *Rhythm of Drum* | *Number of Dances* | |
|---|---|---|
| Eighth notes accented in groups of two | 10 | See No. 2, above |
| Eighth notes unaccented | 89 | See No. 1, above |
| Quarter notes unaccented | 12 | See No. 4, above |
| Half notes unaccented | 1 | Bulletin No. 45, song 189 |
| Each beat preceded by an unaccented beat corresponding to a third count of a triplet | 96 | See No. 5, above |
| Each beat followed by an unaccented beat corresponding to a second count of a triplet | 2 | See No. 3, above |
| Each beat preceded by an unaccented beat corresponding to the fourth count of a group of four sixteenth notes | 14 | See No. 6, above |
| Recorded without drum | 116 | |
| Total | 340 | |

Another characteristic of Indian music is that it does not keep the same time throughout. One measure, for example, will be in 2/4 time and the next may be in 5/4 time. A table showing how this works out for one group of songs is found in the same bulletin on page 183, and herewith follows:

*Change of Time*

| | |
|---|---|
| Songs containing a change of time | 19 |
| Songs containing no change of time | 1 |
| Total | 20 |

The following interesting table, found in the same bulletin on page 183, substantiates the statement made above that the drum and voice do not always keep the same time:

*Comparison of Metric Unit of Voice and Drum*

| | |
|---|---|
| Metric unit of voice and drum the same | 7 |
| Metric unit of voice and drum different | 13 |
| Total | 20 |

The Hindus, I believe, are the master artists at drumming. They have produced percussion instruments of all kinds and descriptions, and it is possible for the drummer to play a whole concerto on his *tabla taranga*.

The percussion instruments used by Uday Shan-Kar, Hindu dancer, in his New York performances, were extremely interesting. He used no less than fifty-six varieties of instruments, most of which were of the percussion type. The *tabla taranga* was the most unique and most interesting of the percussion group. It is a drum with only one head, a little over two feet high, with the base about eighteen inches in diameter and the head about a foot in diameter. These figures are not exact, but they give an approximate idea of the size of the drum. The head is made of parchment, held down by leather thongs. On the top, in the center of the drum head, is placed a black paste made of manganese dust, boiled rice, and tamarind juice, to give it the desired tone. The drummer sits on the floor, places a number of these drums around him in a semi-circle, and plays on them with his hands. By the use of his fingers or his whole hand, and by hitting the drum head in various places, he can produce a variety of tones which are most extraordinary.

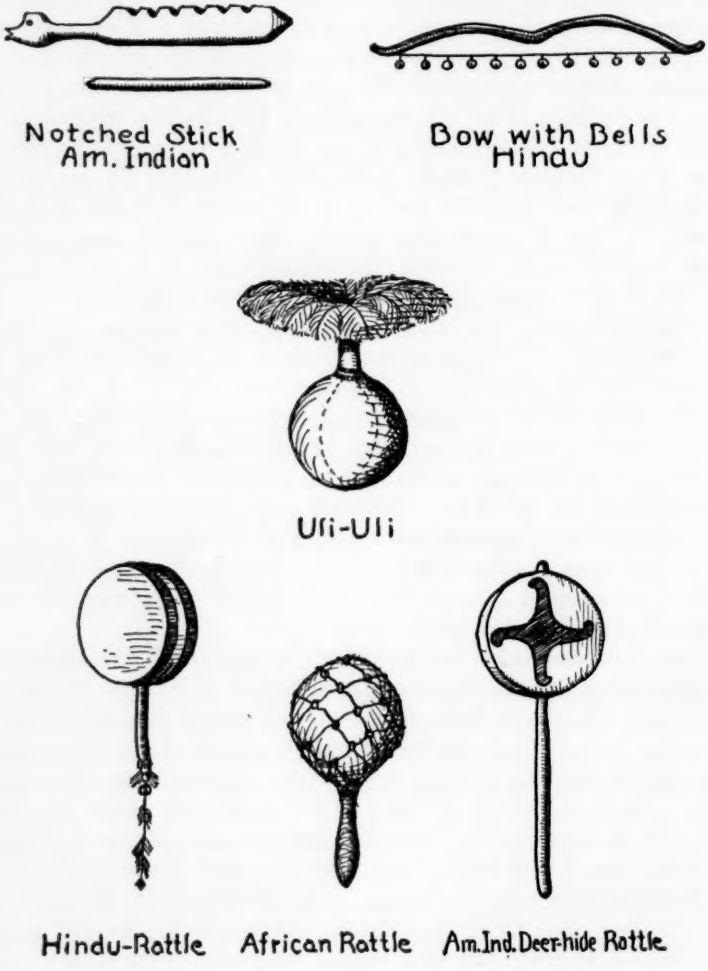
The *mridanga* is a double-headed, barrel-shaped drum. It can be tightened or loosened by means of thongs enclosing small cylindrical blocks of wood which are pushed nearer to or farther from the head which is being tuned. On one of the heads is placed the black paste used also on the *tabla taranga*. The heads are tuned an octave apart.

Another type of instrument is a group of rice bowls filled with varying amounts of water in order to vary the pitch. Of course there are brass gongs, of various pitches and types of tone.

Vera Milanova, in her article, "Hindu Music," which was published in the program of Shan-Kar's company, says: " . . . . with the Hindus and other orientals, rhythm has acquired a much greater importance and an altogether greater development. Bharata, the saint who taught the art of music to the heavenly dancers, who in turn performed for Shiva, is said to have discovered thirty-two kinds of *tala* in the song of the lark. Raja. S. M. Tagore says that the word *tala* refers to beating of time by clapping of hands. Students of Indian music say that musical time in India is a development from meters in poetry . . . But in India up to the nineteenth century there was practically no prose; everything was learned through the medium of verse, chanted to regular rules, so that the sense of duration and rhythm—which is the central idea in Indian music—was very highly developed. The time relations of music are affected both by the structure of the language and by the method of versification. Shiva is supposed to have worked out the different modes of rhythm in his wonderful dance, while Brahma played the hand cymbals and Vishnu the *mridanga.*"

The music and dancing of the Hindus is in one way similar to that of the American Indian, in that its form and quality all have especial symbolical meaning. The salient notes of the *raga,* which is the basis of melody in Hindu music, are fixed by long association and tradition. At first there

RATTLES




were only six *ragas,* but they have multiplied as each acquired a wife and sons; they are supposed to have been handed down by the Gods.

## THE MODERN USE OF PERCUSSION INSTRUMENTS

Such are some of the more salient facts concerning the use of percussion instruments by so-called primitive tribes. Turning now to the modern dance, and the use of percussion instruments therein, we will proceed to give a summary of the results obtained from the survey conducted to discover, by interviewing experts in the dance field, what are the current

attitudes toward this subject. The method of presentation will be to give, first, a list of the questions asked; secondly, a list of the dance authorities interviewed; and, finally, a digest of the answers received.

Following are the questions asked:

What is the aim or purpose of accompaniment?
How do you obtain your accompaniment?
Do you think that percussion instruments are valuable to use for accompaniment?
What are the unique values of the use of percussion instruments for accompaniment?
What are the limits of their use?
What are the principles upon which their use is based?
What are your suggestions for the use of percussion accompaniment in class work?
What is the pupils' response to the use of percussion accompaniment?
Why do they respond thus?
How should percussion instruments be played?
What instruments do you use?
What instruments do you use most commonly and find to be most practical?
Where do you get your instruments or materials for making them?
What is the approximate cost of the instruments?
Can you suggest any references?
Can you suggest the names of other authorities I might interview?

These questions were used in interviewing selected authorities in the dance field, all of whom are resident in New York City. Dancers in the professional and theatrical fields, as well as those in the educational field, were interviewed, in order to get a comprehensive record of opinion on the subject from all those who would be in a position to make use of percussion instruments.

Following is the list of persons interviewed:

I. Dance Instructors in Educational Field
   A. College
      1. Miss Anne Duggan, Teachers' College, Columbia University, New York City
      2. Miss Martha Hill, Instructor in the School of Education, New York University, New York City
      3. Miss Mary P. O'Donnell, Instructor in Physical Education, Teachers College, Columbia University, New York City
      4. Miss Mary Josephine Shelly, Instructor in Physical Education, New College, Columbia University, New York City
   B. Private Secondary Schools
      1. Mrs. Satis N. Coleman, Music Investigator of the Lincoln School, Teachers' College, Columbia University, New York City
      2. Miss Ruth Jones, Instructor in Physical Education, Horace Mann School, Teachers' College, Columbia University, New York City
   C. Public High Schools
      1. Miss Ethel M. Carroll, Physical Education Instructor, Evander Childs High School, New York City
   D. Elementary Schools
      1. Miss Nell Robins, Physical Education Instructor, Lincoln School, Teachers' College, Columbia University, New York City

2. Miss Mary Shafer, Physical Education Instructor, Horace Mann School, Teachers' College, Columbia University, New York City

II. Dancers in the Professional and Theatrical Fields
- A. Miss Elsa Findlay
- B. Miss Emily Hewlett
- C. Miss Hanya Holm of the Wigman School of the Dance
- D. Miss Doris Humphrey

DIGEST OF ANSWERS RECEIVED

*What is the aim or purpose of accompaniment?*

I. When working on technique
- A. Rhythm
  1. It acts as a basis for training in rhythm.
  2. Individuals and groups have the opportunity to feel rhythm and phrasing for themselves, rather than being told the number of steps to take, and so on.
- B. In working from accompaniment to movement
  1. It sets the rhythm for the movement.
  2. It sets the quality of the movement.
  3. It gives the time and force elements.
- C. In working from movement to accompaniment
  1. It accents the rhythm pattern.

*Note*: One should not always use the same piece of accompaniment with a certain movement because the music becomes too firmly associated with it and the usefulness of the movement as a tool in composition is lessened.

II. In the dance itself
- A. When working with a composition which has not been written for the particular dance
  1. Here the music is the meaning of the dance and it inspires or sets the mood and gives the feeling of the thing being done.
  2. It is a means through which compositions involving creative self-expression, when once constructed, can be passed on to other groups.
- B. When the movement is worked out first and the accompaniment is evolved to fit it
  1. The accompaniment is for enlightenment. It reinforces, strengthens, and expresses more clearly the meaning of the dance.
  2. It supports the movement.
  3. It enhances either rhythm or tone color of the dance.

*Note*: The accompaniment should be suited to the dance and form a unity with it.

*How do you obtain your accompaniment?*

In general there are three methods used by the people interviewed: selecting suitable music from compositions already in existence, improvising, and having music especially composed to fit the particular dance.

I. For technique, either selected or improvised music is used.
- A. Improvised music
  1. It is good for classes and work in short forms.
  2. If one has an accompanist who can improvise well, it allows more freedom when working on tools of movement.
- B. Selected music
  1. It is good for rhythmic training.

2. It is absolutely necessary when one's accompanist is unable to improvise.

II. For the dance itself, either selected music or music written especially to fit the dance is used.
   A. Selected music
      1. It is wise in certain instances to work from accompaniment to movement, and let the music inspire the dance.
      2. Useful compositions are hard to find, because music is not generally composed expressly for the dance.
      3. In selecting music from compositions already written:
         a. Select those compositions lending themselves best to the movement and meaning of the dance.
         b. Select simple compositions, especially when working with groups.
         c. Select from good music.
         d. Note that folk music is often good and suitable.
         e. Note that modern music is particularly well suited to the modern dance, because it is almost a movement rhythm.
         f. Note that romantic and classic music is often less useful.
         g. Note that Miss Shafer recommends the books by Marie Hofer, for children's music.
   B. Music composed especially for the dance
      1. This is the only kind to use when the dance originates through movement, because other music seldom fits it.
      2. In using this kind, the dancer and composer must work together very closely and carefully.

***What are the unique values of the use of percussion instruments for accompaniment?***

I. Miss Hanya Holm of the Wigman School of the Dance says that music originated from the noises made by the body in moving; the drum music comes from the clapping, slapping, and stamping noises made by the movement of the dancing body, and therefore is closely united to the dance.

II. Percussion instruments are excellent mediums for studies and individual experimentation in pure rhythm.
   A. The distraction of melody and harmony is removed.
   B. Accent and metrical pattern in rhythm are made concrete.
   C. Percussion instruments are good for practice in syncopation and counterpoint.
   D. They give opportunity to build original rhythm patterns, and to move to them.

III. Percussion instruments are useful when one wishes to divide a large dance group into smaller groups, and let each group work out different problems.

IV. Percussion instruments are particularly valuable for certain types of movements.
   A. They are best for strong, vigorous, or primitive types of movements.
   B. The drum serves chiefly for ecstatic movements.
   C. The gong is good with movements having a sustained quality.
   D. Percussion instruments are extremely appropriate to the modern dance which is as stripped of artificiality as was the primitive dance.

V. Percussion instruments are more economical than other types of accompaniment.

VI. It is easier to improvise on percussion instruments than on a piano; yet it still needs study in order to be properly done.
   A. The student can work out simple forms himself.
   B. Students can accompany their own dances; with elementary grade students, this gives not only joy in creating, but also self-confidence.

VII. Percussion instruments permit more freedom in working from movement to accompaniment; the accompaniment can grow out of the movement.
VIII. They seem to be more intimate than other instruments because one can feel their beat more keenly.
IX. The teacher can give herself more directly to the class, instead of making the longer circuit through the accompaniment and the piano.
X. Percussion instruments offer a good means of approach in interesting the athletic child in the dance.
XI. They have a strong appeal for men and boys.
XII. Their use is in keeping with progressive educational theories.
A. They allow the freer creative method of teaching, in which the teacher helps the groups in building its own dances.
B. A tie-up can be made with other courses by making and decorating one's own instruments or by studying the primitive uses of percussions.
XIII. They are fine, valuable, and exciting for use in dances for which they are particularly appropriate.

*What are the limits of the use of percussion instruments?*

I. They should not be used to the exclusion of other types of music.
II. They do not furnish a complete accompaniment for certain types of work.
III. They lack, to a great extent, melody, harmony, pitch, and different voices.
A. These requisites can be obtained with a sufficient variety of instruments of the percussion type.
B. Melody and harmony should not be altogether excluded from a student's experience.
IV. Percussion instruments are not suited to certain types of movements; a waltz, for instance, needs a full-flowing melody which can only be obtained with other instruments.

*What are the principles upon which the use of percussion instruments is based?*

I. Percussion instruments should be used with discrimination.
II. They should be used only when the quality of the tone is suited to the movement and meaning of the thing being done. They should assist in reaching the objective of the dance.
III. Each instrument must be played according to certain rules; one should never simply pound on it.
IV. One should know the nature of each instrument, and when and how to use it.
A. How to beat it to produce different effects.
B. What kind of beater to use to get certain effects.
C. Where to beat the instrument.
V. Each instrument should be explored to find its individual possibilities.
VI. There are innumerable ways of using and changing the tone and its quality; the field is open to one's own discovery.
VII. The drum should be used sparingly because of its mechanical effect on the class.
VIII. One should use discrimination in combining percussion instruments with other instruments. The use of a piano and a drum together is generally objectionable.
IX. Miss Doris Humphrey believes that percussion instruments should be used in contrapuntal accent to the dance; the beat should be secondary and should follow on weaker or unaccented beats of the movement.

*Suggestions for using percussion instruments in class work*:

The ways of using percussion instruments in class work are as innumerable as the instruments and the ways of playing them. They should

be used in accordance with the principles outlined above, and should be used when the need arises or an interest in them is shown. The following are a few general suggestions as to how and when they might be used:

I. In working with rhythm
   A. Rhythms may be studied by clapping hands, beating on the floor, stamping, beating percussions, etc.
   B. The class may listen to rhythm patterns and try to reproduce them themselves.
   C. The class may invent its own rhythm patterns.
II. In working from accompaniment to movement
   A. The student, instructor or accompanist may make the accompaniment, and then the student may work out movement to fit it.
   B. To test the sensitivity of a student to changing rhythms, a changing accompaniment may be played and the student may attempt to respond to it in movement.
III. In working from movement to accompaniment
   A. The student starts with a certain movement and works out his own accompaniment to fit it.
IV. In creating a dance
   A. The dancer and accompanist must work together. The dancer must be able to feel what is needed and to choose from the suggestions made by the accompanist. The latter must have a keen feeling for the quality and meaning of the dance.

*What is the pupil's response to the use of percussion accompaniment?*

All the people interviewed replied that the students enjoyed using percussion accompaniment for strong, vigorous movements, and that they found it exciting and interesting if used in moderation. One found that, with elementary school children, the response was not so good as when the piano was used, except in Indian dances, when the students knew it was part of a game.

*Why do they respond thus?*

I. Because of the simplicity of the accompaniment.
II. Because of its appeal to primitive rhythm.
III. Because the student can actually participate in the accompaniment.
IV. Because it is more vital and exciting and closer to the individual.
V. Because it is clarifying in rhythm, pattern, counterpoint, and syncopation.
VI. The elementary school children respond better to the piano because the child feels the whole picture and he does not get it with the beat alone.
VII. At Lincoln School there is a definite tie-up between the music and art departments, because the students make their own drums and play them in their orchestra. This gives an added interest when they use them as dance accompaniment.

*How should percussion instruments be played?*

I. The whole body should be used; when the instrument is carried in the dance, the whole body should be used as a base.
II. The tone should never be beaten into the instrument, but should be drawn out of it.
III. One should strive for flexibility of fingers, hands, wrists, and shoulders when playing.

IV. One should be able to use either hand, or both hands.
V. One should experiment with the instrument to find out where the best tone can be produced, and what effects can be obtained by the use of different types of beaters.
VI. Drums give a better tone when not beaten in the exact center, because the vibrations from the side seem to come together and neutralize the effect.
VII. Gongs
  A. Produce different tones in different areas.
  B. The tone changes from day to day.
  C. Gongs give a better tone if they are swinging when they are hit.
VIII. A wire brush or the handle of a stick are convenient for giving different effects.

*Instrumental technique*:

The following notes were taken from the book written by J. E. Maddy and T. P. Giddings on *Instrumental Technique for Orchestra and Band*, published by the Willis Music Company in Cincinnati, Ohio, 1926. They are included here because they offer useful suggestions relative to the technique of playing percussion instruments in the dance.

I. The care of the instrument
  A. Snare drum
    1. The heads should be tightened evenly so that tension is even all around.
    2. Heads should be loosened in damp weather after using.
    3. The snares should be tightened evenly to respond to the vibrations of the heads.
  B. Bass drum
    1. Same as for snare drums, except for snares.
  C. Timpani
    1. Same as bass drum

II. Technique of playing
  A. Snare drum
    1. May be played while sitting or standing.
    2. The drum is placed in a tilted position at the level of the hips.
    3. Position of hands on the sticks:
      *a*) With the right hand, the stick is held palm down, the little finger three inches from the larger end, the grip of the little finger around the stick, the other fingers barely touching.
      *b*) The left stick is held between the thumb and forefinger, palm up with the thumb and forefinger three inches from the larger end of the stick. The first and second fingers are gripped around the stick and the other two are placed under it.
    4. The roll is produced by striking twice with the left stick, then twice with the right stick; and continuing in this manner.
    5. The drum should be struck near the edge when played softly, and near the center when played loudly.
  B. Bass drum
    1. It may be carried or placed on a stand so that the player may strike it without bending forward.
    2. It is struck with a glancing blow at a point about one-third the distance across the head.
    3. The bass drum roll is played by holding the stick in the middle and swinging the wrist so the ends strike alternately. A double-headed stick is preferable for this.

C. Timpani
   1. The drum should be elevated, so that when the player is standing his extended hands are on a level with the hoops of the drum.
   2. The sticks are held loosely between the thumb and forefinger, thumbs up, the ends of the sticks reaching only to the outer edges of the palms.
   3. The timpani roll is made with single strokes. The player may practice the snare drum roll for relief from fatigue.
   4. The drum should generally be struck at a point one-fifth of the way across the head. Special effects may be obtained at other points. A roll starting *pp* and increasing to *ff* should start near the edge and end in the center with the sticks raised higher as the volume increases.

D. Cymbals
   1. They are held by straps which are attached to the center.
   2. They are played by striking them against each other with glancing blows, in a swinging motion.
   3. The cymbal roll is played by suspending one cymbal and playing on it with timpani beaters or drum sticks. It may also be played by holding two cymbals three inches apart and parallel, and striking a drum stick against the disks.

E. Tambourine
   1. There are several ways of playing this. It may be shaken, or tapped with the fingers or knees, or placed on a pillow and beaten with drum sticks.
   2. The roll may be produced by holding the tambourine in a horizontal position with the left hand and rubbing it with the moistened finger tips of the right hand.

F. Triangle
   1. This is suspended by a chord and struck with a steel bar.
   2. The roll is produced by shaking the beater rapidly from side to side near the corner.

G. Xylophone and orchestra bells
   1. These are elevated to the same height as the timpani and the player stands while playing.
   2. The hammers are held in the same way as the timpani sticks.
   3. They are played like a piano and the single stroke, or timpani, roll is used.

III. Tuning

A. The snare drum is tuned by adjusting the tension of the heads to the point where the desired snap results when the drum is struck. The snap is caused by the snares rebounding when the opposite or beater head is struck.

B. Timpani
   1. These are tuned by tapping around the edges with the fingers of the left hand and tightening with the right. When the edges are in tune the whole drum is in tune and the tone is clear.
   2. Dampening the head with a wet sponge will revive the tone when it becomes dead.
   3. In pedal or machine timpani the small drum is tuned to *B* flat and the large one to low *F*.

C. Tambourine heads may be tightened by wetting and then drying thoroughly.

### *What instruments do you use?*

There are a great many kinds of percussion instruments which can be used. The following is a list of those which have been used by the people interviewed:

I. Instruments
- A. Bowls filled with water
- B. Castanets
- C. Hallowe'en noise-makers' toys
- D. Clapping hands, body, floor
- E. Cymbals: small, large, finger
- F. Drums
  1. Tom-toms
  2. Wigman tambour drums of various sizes
  3. Bass drums
  4. Kettle-drum
  5. Home-made drums
  6. Drums made of gourds
- G. Glockenspiel
- H. Gongs of various types
- I. Gourds
- J. Rattles
- K. Seed pods from poinciana trees
- L. Stamping
- M. Strings of piano beaten with drum or gong sticks
- N. Tambourine
- O. Triangle
- P. *Ule ule*
- Q. Wood blocks
- R. Xylophone
- S. Zither

II. Beaters
- A. Fingers
- B. Hands
- C. Handles of beaters
- D. Hard-headed beaters
- E. Soft-headed beaters
- F. Timpani beaters
- G. Wire brush
- H. Xylophone beaters with heads covered by felt

*What instruments do you use most commonly and find to be most practical?*

I. Drums of various kinds
II. Gourds and rattles
III. Gongs
IV. Hands
V. Feet

*Note*: The timpani beater is said to be the most useful

*Where do you get your instruments or materials for making them?*

I. Instruments may be bought at the following places:
- A. Harry Dixon, Tillman Place, San Francisco, California (gongs made to order)
- B. Fred Gretsch Manufacturing Co., 60 Broadway, Brooklyn, N.Y. (single-headed drums and beaters)
- C. La Fiesta Mexican Handicrafts, 38 West 8th St., New York (drums and gourds)

D. Ludwig and Ludwig, 1611 N. Lincoln St., Chicago, Ill. (cymbals, finger cymbals, maracas or Cuban gourds, tambourines, castanets, etc.)
E. Porto Rico, Cuba, for Cuban gourds and rattles.
F. Regular music instrument stores.

II. Materials for making drums may be bought at the following places:
A. C. W. Danneheuer, 143 4th St., Philadelphia, Pa.
B. Industrial Arts Cooperative Service, Inc., 519 West 121st St., New York City.

*What is the approximate cost of the instruments?*

I. Gourds may be obtained from Porto Rico for $.75 a pair.
II. The Wigman tambour drums range in price from $5.50 for the small drums and two beaters, to $10.00 for the large drums.
III. The price of gongs varies depending on the size and the kinds of metal used, and ranges anywhere from $10.00 to $150.00.
IV. *Ule Ule* may be obtained from Hawaii for $6.00. The price varies according to the quality of the feather decorations.
V. Indian drums have a wide range of prices, and may be obtained directly from the Indians. Also they may be made very inexpensively; the drum heads may be obtained for $.75. The following books give excellent descriptions of how to make drums and other percussion instruments:
A. Satis N. Coleman. *The Drum Book,* New York: John Day Co., 1931.
B. Satis N. Coleman. *The Marimba Book; How to Make Marimbas and How to Play Them,* New York: John Day Co., 1930.
C. J. H. Salomon. *The Book of Indian Crafts and Indian Lore,* New York and London: Harper Brothers, 1928.

## SUMMARY

1. Percussion instruments are valuable to use as accompaniment in the modern dance.

2. They have certain unique qualities that make them particularly useful in the dance of the present-day.

3. They have certain limitations which should be recognized; they should not be used exclusive of other types of instruments.

4. Their use should be based on definite principles.

5. They have intrinsic interest for the students.

6. There are definite techniques for playing these instruments, but at the same time the field is open for one's own experimentation.

7. There is a wide range of instruments which can be used, and this fact enhances their possibilities and values.

8. Much can be learned from primitive tribes and Oriental peoples concerning instruments that can be used, the technique of playing them, their ways of using these instruments in the dance, and their methods of making the instruments.

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# The Problem of the Nutritional Status of a College Group*

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IN EXAMINING an incoming class of nude freshmen, nothing is quite so impressive as the striking variation of weight and build. And as one follows individuals of this group through their college years, he sees changes in development of build no less striking. It was the hope of finding some of the factors influencing this change and the possibility of fostering a favorable development in those individuals in whom it did not spontaneously occur that led to the studies now being carried out.

For this purpose we have taken 1,765 records of male freshmen entering the University in the years 1931 and 1932, on which are based the following observations. For classification we have used two sets of reference: the weight-height†[2] ratio, and the observations on normal weight of Diehl.*[1]

In comparing the incidence of weight-height[2] ratio in our group with that of Davenport,[2] the curve of our group is more nearly symmetric in its two limbs than his; also the median of our group is twenty-nine, while his is thirty-three. (See Figure 1.) This means that his group of persons was much stockier, that is, they were heavier for their height. The age of his group is not given in this table, but it is probably greater than that of the group with which we deal. Using his classification of build as listed in Table I, the larger group of our students falls in the slender rather than the medium class.

Comparing this group with standard tables of normal weight, we have used the usual insurance tables, subtracting four pounds for clothing. Diehl[1] has found from an analysis of many thousand college students that these tables are suitable for a normal standard of reference for this age group. In Table II, we see the incidence of under- and overweight. Twelve per cent of students are 11 per cent or more under normal weight, and 27 per cent are 6 per cent or more under normal weight. On the other hand, 17 per cent are 10 per cent or more overweight.

What are the prospects of bringing these underweights up to their normal weight? In considering this question there are two indications that it is feasible. In Davenport's build chart the medium was con-

*Read before the annual meeting of the Pennsylvania-New Jersey section of the American Student Health Association at Philadelphia, May 27, 1933.

†Numbers refer to bibliography at end of article.

siderably higher than in this group, and it is well known that weight tends to increase with age, especially in the age group with which we are dealing, for these boys have not all reached their full development. Furthermore, in a series of underweight persons in this group, there has been an average gain of 8.8 pounds and an average growth of about 0.2 inches in those under observation two years, and 2.6 pounds in those observed seven months without any regulation of diet or activities whatsoever. I think we may fairly conclude, then, that the chance of increasing the weight of these students is good.

The problem involved in bringing this underweight group up to normal is not simply a matter of the addition of body weight. What sort of body tissue can be added to these individuals? Is it possible to add muscle tissue or "fat" tissue at will? At the present time we have under observation about a third of the markedly underweight group. We have given them an augmented diet on which most of them gain flesh more or less rapidly. What sort of body tissue is this? Obviously not muscle; probably largely fat and carbohydrate storage. If now one subjects such a person previously thin to the stimulus for building muscle tissue, namely graded exercise, will a gain in muscle weight offset a loss in tissue storage gained through an increased diet? These are some of the questions about which we hope to get information in the present study. The problem is fundamental in bringing the post-adolescent to robust adult development.

TABLE I

INDEX OF BODY BUILD: WEIGHT-HEIGHT$^2$ RATIO

| Class | Index | Incidence | Per cent |
|---|---|---|---|
| Very slender ..... | 20.5–25.4 | 89 | 05.0 |
| Slender ..... | 25.5–30.4 | 948 | 54.0 |
| Medium ..... | 30.5–36.4 | 611 | 34.8 |
| Fat ..... | 36.5–43.4 | 99 | 05.6 |
| Very fat ..... | 43.5–64.4 | 8 | 00.4 |

TABLE II

PERCENTAGE OF NORMAL WEIGHT

| Percentage Normal Weight | Incidence | Per cent |
|---|---|---|
| 70–79 | 11 | 00.6 |
| 80–89 | 216 | 12.2 |
| 90–94 | 270 | 15.3 |
| 95–99 | 397 | 22.5 |
| 100–109 | 543 | 30.8 |
| 110–119 | 207 | 11.7 |
| 120–179 | 120 | 06.6 |
| 210–219 | 1 | 00.05 |
| | 1765 | |

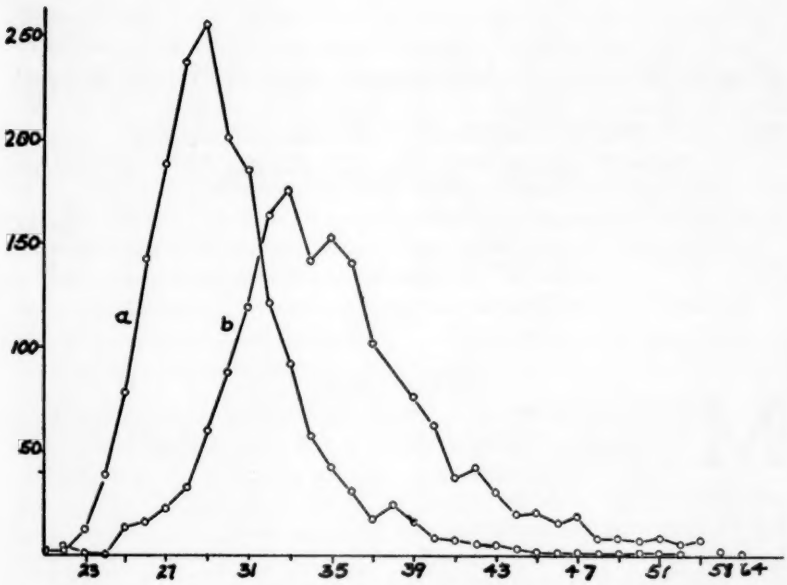


FIGURE 1.—Index of body build: weight-height[2] ratio; abscissae, incidence. The incidence of body build; *a* is college group, *b* that of Davenport.[2]

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[1]Diehl, H. S. Personal communication.

[2]Davenport, C. B. *Body Build and Its Inheritance.* Carnegie Institute, 1923.

# The Effect of Massage upon Peripheral Circulation as Measured by Skin Temperature

By Dorothy Kelso, Margaret Anne Fosse, and Fae Henry
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## INTRODUCTION

MUCH of what we know concerning physical therapeutic aides is based upon clinical experience and empirical evidence. This study is an attempt to give experimental evidence as to the characteristic reaction of the peripheral circulation to massage of the thigh and leg. In reviewing the literature, one finds that numerous methods have been employed to determine the efficiency of the blood flow of the extremities. The oldest is that of observation of the part, both as to subjective symptoms and objective signs. In 1909 Hewlett and Van Zwaluwenburg applied a pletysmograph to the arm. Pressure was produced just above the pletysmograph with a sphygmomanometer to such a degree as to occlude the veins but to leave the arteries open. The varying volume of the arm substance was then recorded on paper by means of a lever. The disadvantages of the pletysmograph are: that the curves are often marred by respiratory movement, that the pressure of the cuff must be applied very suddenly in order that the vein may be occluded from the start, and that the application of the pressure is often followed by an immediate change in the volume of the arm within the pletysmograph.

Stewart in 1911 devised a means by which the hand or foot might be placed in a calorimeter, the degree of heat given off being a function of the circulation. However, Broos and Jostes (1924) believed that the limits of the error in this method are so great that it is valueless when applied to an extremity in which the volume diminishes. The method is also clumsy.

The disappearance time of wheals produced by physiological saline solution injected intracutaneously at four-inch intervals up the leg and thigh is the basis for determining the circulatory condition in the test described by Stern and Cohen in 1926. Sixty minutes is the normal disappearance time, but in all cases of circulatory deficiencies, the disappearance interval is diminished.

Wolfson (1931) cannulated the femoral veins of animals, and through a pneumatic system, recorded the reaction of the circulation to massage. Obviously, this method cannot be used on human beings.

Numerous investigators among whom are Benedict and Parmentar

(1929), Eddy and Taylor (1931), Talbot (1931), and Rusch (1931) have used thermocouples for measuring skin temperature. The method is based upon the well-founded assumption that the surface temperature of the part is an index to the adequacy of the underlying blood supply. If there is an increase in the circulation of the part, there should be a resulting increase in temperature. This method was used in the experiments to be reported, in an effort to determine the changes in peripheral circulation brought about by massage. Thermocouples, which consist of two dissimilar metals joined in such a way as to form a complete metallic circuit, were used to measure the changes in surface temperature. When the two junctions are at different temperatures, there is a difference in potential and an electric current flows. If a galvanometer is inserted in the circuit, the magnitude of the current may be measured. The law of the thermocouples is that the magnitude of the current is proportional to the difference in temperature between the two junctions.

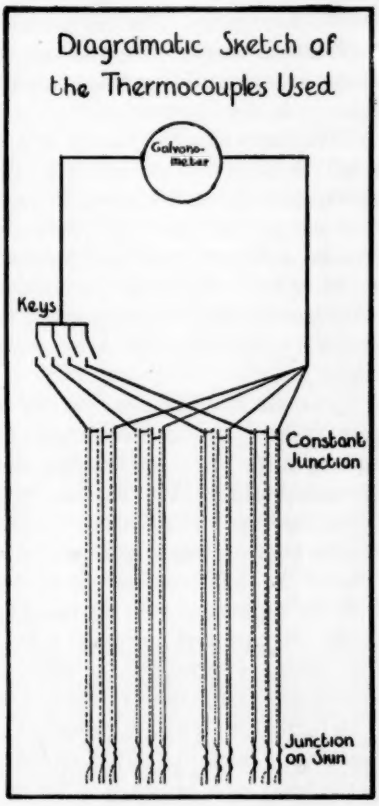


FIGURE 1

The apparatus used consisted of three thermocouples in series. The couples were made of number thirty-seven copper and constantan wire which was considered thin enough to minimize heat conduction from the skin surface but heavy enough to be unbreakable under ordinary conditions. Figure 1 is a diagrammatic sketch of the four sets of thermocouples used in this experiment. The couples, which were threaded through a rubber holder attached to the skin with adhesive tape, were held at constant pressure against the skin by fifteen-gram weights hung from each. This method was first described by Rusch (1931), working in this laboratory. The wires were bared and exposed at the junction of the copper and constantan, the remainder of their course being insulated. To complete the metallic circuit, the second bared junctions were placed in a constant temperature bath of mineral oil kept in a well insulated pint thermos bottle surrounded by feathers in a large porcelain crock. The temperature of the mineral oil was read on a fine di-

vision centigrade thermometer. The difference in temperature between the two junctions was measured by a d'Arsonual galvanometer. Passing from the constant temperature bath to the galvanometer were copper leads. Keys were inserted in the circuit so that only one series of thermocouples would be read at one time.

The thermocouples were calibrated by placing them in a test tube containing mineral oil, then placing it in a double-walled water bath in a thermos jug. The test tube also contained a fine division centigrade thermometer. The drift in temperature was very slow, falling about 4° C in twenty-four hours. The galvanometer deflections were checked against these actual temperature readings, and a graph was constructed, whereby changes in electrical potential could be read off directly as temperature changes in degrees centigrade.

The room in which the experimental procedures were carried out was small. It had only one window and one door, and both were treated to eliminate drafts as far as possible since these affect both the skin temperature and the thermocouple readings. Dry- and wet-bulb temperature determinations were made and the relative humidity was calculated.

In order to check upon temperature findings and to give added information concerning the reaction of the circulation to massage of the lower extremity, simultaneous heart rate and blood pressure readings were taken.

The effects of massage on circulation depend much on the type, the part affected, the intensity, and the duration of the manipulation. The reports in the literature disagree as to the direction and magnitude of the changes produced. Experiments have been done with many differing published findings. As concerns the heart rate, the majority of the workers believe that an increase is produced by massage. Wolfson (1931) cannulated the right femoral vein of dogs and recorded the blood flow, taken with the saphenous vein ligated. Deep kneading decreased the pulse rate in one attempt, and increased it in twenty-one. Pemberton (1924) found that massage increased the pulse rate and believed the affect to be a mechanical rather than a chemical one. Hunt (1925) and Kellogg (1895) both found that massage brings on an increase in the rate and force of the heart beat. Bucholz (1917) reports an inverse relation of blood pressure to the heart rate. Massage of the extremities results in an increased blood pressure and an accompanying decreased pulse rate. On the other hand, Graham (1913) believes that the heart action is generally lessened in force and frequency. Kleen (1921), quoting from nine sources, shows the variable nature of the results obtained. He reports that Eccles, Rosenthal, Hasebrook, Romano, and Ekgren found a diminished pulse rate, while Zabludowski, Kronecher, and Stirling found an increase. Finally, Mitchell and Gulick (1904) report either a slowed or hastened pulse rate, depending on the methods used.

Much that has been said in the literature concerning the effect of

massage on pulse rate is presented without experimental evidence. Mennell (1920) and Nissen (1929) report an increase in heart rate due to the pressure of the stroke assisting the venous return, and to its reaction on the vasomotor tone. McKenzie (1924) believes that massage increases the rate and force of heart action. On the other hand, Despard (1920) states that deep manipulation causes a decrease in the rate of and an increase in the strength of the heart beat.

Nothing definite can be deducted concerning the effect of massage on blood pressure, due to equally conflicting evidences and opinions. In his experiments, Bucholz (1917), found that massage of the extremities raised blood pressure. Kleen (1921), quoting from the sources listed above, in contrast to the results on pulse rate, found that they all agreed that massage brought on an increase in blood pressure. From his own experiments, he found either a rise or fall, with the rise more usual. Kellogg (1895), verifying an experiment done by Brunton, showed that general massage produced an initial though transitory rise in arterial pressure. Mitchell and Gulick (1904) discovered that the effects vary with the method of stroking, deep massage producing an increase, and superficial, a decrease in blood pressure. Graham (1913), found that general massage produced a fall in the level of the blood pressure, but vigorous abdominal massage abolished the fall. Nissen (1929), and Mennell (1920), authorities on massage, both believe that it decreases blood pressure. Nissen (1929) found a decrease of as much as 9 mm. On the other hand, McKenzie (1924) reports no change in either direction.

It is evident from the above review of the literature that much remains to be done before the question of the effects of massage upon the circulation is satisfactorily answered. The purpose of this experiment is to obtain objective evidence by a method hitherto unused in the solution of this problem.

## METHOD

The standard procedure was as follows. The subject, a normal, healthy young woman, came to the laboratory one hour before the actual observations were to begin, changed into a cotton bathing suit, and reclined on a bed. The experiments were performed at the same time of day and under uniform physiological conditions. The room was kept at a temperature of 80° F. This was found to be comfortable for the subject, whose prolonged inactivity and scanty clothing made it necessary to keep the room warm. The extremities were exposed from the hips down. From preliminary experimentation it had been determined that a subject will come to equilibrium with the room temperature under the conditions of this experiment within a forty-five-minute period. After the subject was fully acclimatized, the distal extremities were supported in a special harness. The subject assumed a supine position, supported at the hips and at the heels. A rest was made for the knees so that they might be slightly flexed.

Using the special applicator described, the warm junction of the ther-

mocouples was applied to the skin over the fleshy portion of the ventral aspect of the thigh and the dorsum of the leg, and firmly fastened with adhesive tape. Operator No. 1 noted the galvanometer deflection for each of the four thermocouples once every minute. Operator No. 2 took the heart rate every sixty seconds using a Bowls stethoscope applied with adhesive tape over the precordium. Operator No. 3 observed the blood pressure by the auscultatory method at the same intervals. Premassage observations were recorded. A physiotherapist from the State of Wisconsin General Hospital administered the massage consisting of two minutes of stroking, three minutes of petrissage, and two minutes of stroking, first to the thigh and then to the leg. The thermocouples were removed from the massage extremity during the procedure. Those on the unmassaged limb were not disturbed. Two minutes elapsed after the completion of the total massage before the temperature readings were resumed. During this interval the thermocouples were reapplied to the massaged side. Heart rate and blood pressure readings were continuous. Great care was taken to eliminate all unnecessary movements and noise on the part of the operators so as to prevent disturbing the subject psychically and to avoid affecting the exposed warm junctions of the thermocouples by drafts. In many cases the subject fell into a light sleep during the experimental procedure.

## RESULTS AND THEIR DISCUSSION

Figure 2 is a graphic representation of the skin temperature reaction to massage. This is a composite of five observations on one individual. Note that the temperature of the thighs is approximately one degree high-

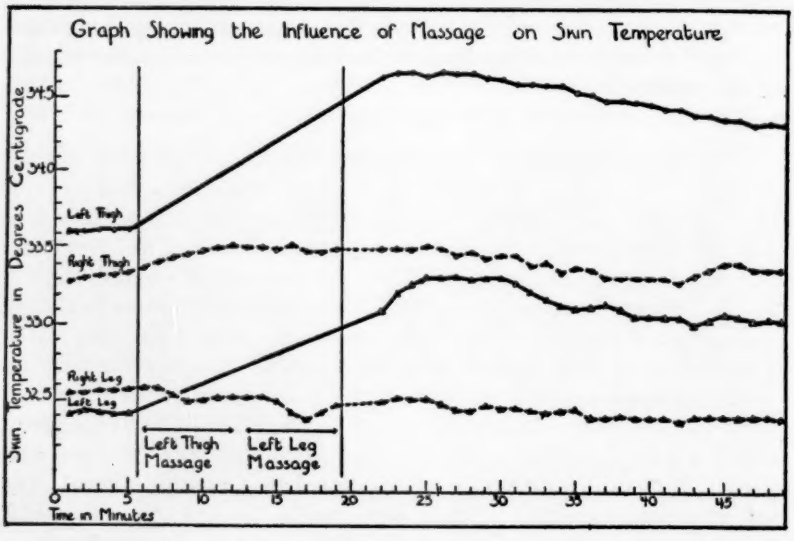


FIGURE 2

er than that of the legs. This is in accord with the findings of other investigators (Benedict, 1929, and Talbot, 1931) who have observed a similar vaso-gradient to be present. In a study of the reaction of the left thigh to massage, it will be noted that ten minutes after the massage was completed, the temperature had increased 0.99 degrees Centigrade. In two more minutes it elevated slightly more to make a total increase of 1.05 degrees. There then followed a graduate fall in temperature. When observations ceased 37 minutes after the massage, the temperature had failed to come back to the premassage level. On the other hand as a result of the manipulation, the unmassaged thigh increased only 0.16 of a degree in temperature. This was followed by slight oscillating changes. By the end of the experiment, it was approximately at the premassage level.

In studying the reaction of the left leg, which was massaged *after* the left thigh, a similar increase was recorded. The observations began two minutes after the massage. A delayed rise in skin temperature occurred with the peak coming six minutes after the completion of the massage. After remaining at this peak level for six minutes, the temperature began to fall but did not come to normal within thirty minutes.

As compared to this very definite reaction, the unmassaged leg showed little temperature change other than might be attributed to ordinary physiological variation of human tissue. The loss in temperature during the massage period occurred while petrissage was being administered to the leg, and was undoubtedly due to wind effects.

A series of confirmatory experiments were conducted on two other subjects, healthy young women, with essentially the same reactions as here outlined.

From the evidence thus far presented, it would seem that the effect of massage upon the peripheral circulation is local rather than systemic in nature. Because so little temperature change occurred in the unmassaged extremity, slight changes in blood pressure and heart rate might be ex-

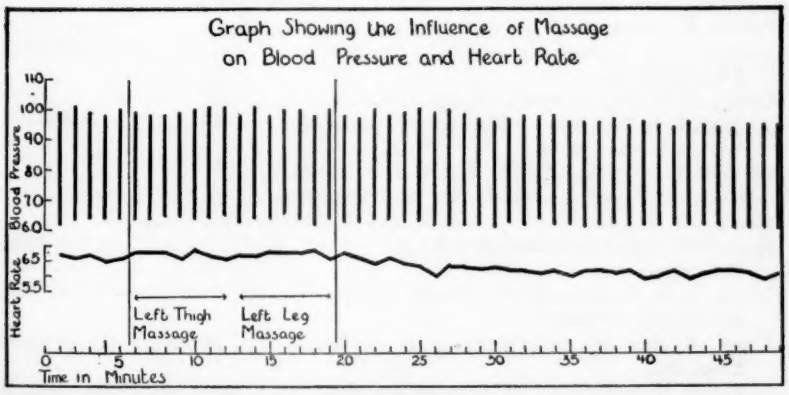


FIGURE 3

pected. Figure 3 shows the influence of the massage procedure described upon the heart rate and blood pressure. There was no indication of a reaction of the blood pressure and heart rate to massage other than might be accounted for by the long continued rest in the recumbent position. There was a very slight tendency for the systolic pressure to fall, the diastolic remaining practically unchanged. There was a very slight decrease in heart rate, but on the whole the blood pressures and heart rate were remarkably constant.

The late occurrence of the maximal rise in temperature contradicts the assumption that the increase is secondary to friction. It was probably due to a vaso-dilatation coming on as a result of mechanical stimulation. The studies of Krogh (1929) and Carrier (1922) demonstrated that stroking produced a capillary dilatation the duration of which was related to the degree of pressure. The vascular change had not subsided in one-half hour in the experiments described in this paper and the average temperature at that time was still above normal by 83.5 per cent.

## CONCLUSIONS

1. Massage produces a local increase in temperature.
2. The temperature change is relatively long continued.
3. The evidences suggest that it is secondary to local vasomotor change.
4. This is of such a nature that the heart rate and blood pressure remain practically unchanged.

The authors wish to acknowledge the kind assistance given by Dr. Frances A. Hellebrandt under whose direction the experiment was performed, of Mr. Frank Maresh, for help in the construction of the thermocouples, and of Meryl Miles for administering the massage in many of the experiments.

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# A Comparative Study of Methods of Classifying Pupils into Homogeneous Groups for Physical Education*

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## PROBLEM

THIS study grew out of the desire to find an objective method for classifying junior and senior high school boys into homogeneous groups for physical education, which would make possible quick and proper placement of the boys for participation in the activities of the program. We were interested primarily in finding a device which would be characterized by the factors of economy in time, equipment, and effort and which would also furnish the teacher with some additional information about the individual that would be of value in program planning.

## PROCEDURE

*Setting Up the Criterion.*—Our first step consisted in setting up the criterion by which we could evaluate the methods compared. We did this by dividing the one hundred boys used in the study into six classes. We made no effort to keep the relative numbers in the classes the same, but placed each boy in the class to which we thought he belonged, regardless of the number assigned to that group. Each group was made as homogeneous as our subjective judgment permitted. This judgment was based upon the impressions we had gained during a year of rather intimate association with the boys. We were conscious of the fact that the validity of the study depended upon the trustworthiness of our subjective judgment. Consequently we gave this matter very careful consideration.

*Administering Tests.*—We next administered three tests, the Brace motor ability,[1] the Rogers strength,[2] and the McCloy motor capacity.[3] The techniques and the scoring methods used in each were those recommended by the respective authors of the tests.

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* A paper presented before the Research Section at the Mid-West District Association Convention, March 30, 1933, at Wichita, Kansas.

1 David K. Brace, *Measuring Motor Ability*, New York: A. S. Barnes & Co., 1927.

2 F. R. Rogers, *Fundamental Administrative Measures in Physical Education*, Newton Mass.: The Pleiades Co., 1932.

3 C. H. McCloy, unpublished article, A Classifying and Grading System For Physical Education Based on Measurements of Motor Ability.

You are no doubt all familiar with the Brace and the Rogers tests, hence they need no explanation here. However, since the McCloy test is as yet unpublished, it might be well to describe it briefly.

TABLE 1

McCloy Motor Capacity Test

1. Classification index + 20(age) + 6(height) + weight.
2. Brace test = number successfully done.
3. Sargent jump = height jumped above standing height.
4. Burpee test = coordinations completed in ten seconds.
   Total of weighted scores = *General Motor Capacity*.

This motor capacity test as used, included the four factors of: (1) classification index, which was determined by finding the sum of 20(age) + 6(height) + weight; (2) the Brace test which was scored by taking the number of stunts successfully done; (3) the Sargent jump record, found by measuring the height jumped above the standing height; (4) the Burpee score, which equaled the number of times the boy assumed the squat-rest position, extended the legs to the front leaning-rest, returned to the squat-rest and stood erect in ten seconds. The sum of the weighted scores made, gave a general motor capacity score for the individual.

*Selection of Factors for Correlations.*—Twelve factors were selected from the three batteries of tests and the scores were analyzed by computing simple, partial, and multiple correlations with the criterion. Efforts were made to determine the most useful single factor, and the best possible combinations of factors for classifying boys in physical education.

In addition to the criterion (*O*), which as has been explained, was the subjective classification of the boys made by the writer, the factors used were: (*S*) a weighted strength index made up as follows: 1/3(sum of grips) + .1(back lift) + .1(leg lift) + 1(chinning strength) + 1.5 (dipping strength)—3.5(weight), (*M*) a short strength test score found by taking (grip strength) + (chinning strength) + 2.5 (dipping strength) — 5(weight). The chinning and dipping strength in this formula was figured by the McCloy formula for same, (1) the classification index score, involving age, weight, and height and determined by the formula as given above; (2) Rogers' strength index score, the sum of items scored as in the Rogers test; (3) chinning strength, determined by the McCloy formula[4] which is 3.42(number of chins) + 1.77(weight) — 46; (4) general motor capacity score which equals the sum of the weighted scores of the factors involved in the McCloy test; (5) number of chins; (6) Sargent jump; (7) Brace test; (8) motor quotient, found by dividing the boy's achieved motor capacity score by the norm for his

[4] C. H. McCloy, "A New Method of Scoring Chinning and Dipping." Research Quarterly, II: 4 (December, 1931).

classification index; (9) chinning physical fitness index, found by dividing the chinning strength by the norm for weight; (*C*) Rogers' physical fitness index which was determined by dividing the strength index score by the norm for age and weight. These factors together with their correlations with the criterion are summarized in Table 2.

TABLE 2

RESULTS OF CORRELATING CRITERION (*O*) WITH FACTORS (*S* TO *C*)

| | | |
|---|---|---|
| S. | Weighted strength index | $rOS = .888$ |
| M. | Short strength text | $rOM = .875$ |
| 1. | Classification index | $rO1 = .832$ |
| 2. | Rogers' strength index | $rO2 = .830$ |
| 3. | Chinning strength | $rO3 = .826$ |
| 4. | General motor capacity | $rO4 = .780$ |
| 5. | Number of chins | $rO5 = .699$ |
| 6. | Sargent jump | $rO6 = .597$ |
| 7. | Brace test | $rO7 = .441$ |
| 8. | Motor quotient | $rO8 = .327$ |
| 9. | Chinning physical fitness index | $rO9 = .303$ |
| C. | Rogers' Physical fitness index | $rOC = .245$ |

## FINDINGS

*Simple Correlation Results.*—From the results of this study it would appear that the single factor which correlates highest as a classifying device, is the weighted strength index. The short strength test ranks a close second with a correlation of .875 and because of the fact that its administration requires relatively little equipment as compared with that necessary in finding the weighted strength index score, this factor will be preferred by many as a classifying tool. Classification index which as you will recall, was determined by merely taking 20(age) + 6(height) + weight is fourth, just a bit ahead of the Rogers strength index. This device is characterized by simplicity but does not provide the useful information obtained through the Rogers test. Chinning strength, the fifth highest of the items is relatively easy to compute, and as will be noted later in the discussion, is a very important factor in the combinations which give the highest results among the multiple correlations. The general motor capacity score, which ranks sixth, may well be considered as a classifying device since its computation gives the teacher varied and useful knowledge about the boy without necessitating certain equipment not always easily obtained by the small school, and so supplies an essential in today's pupil-centered program. The very simple procedure of using the number of chins made, as a classifying device, would appear to have, judging from this study, reasonable justification.

*Multiple Correlation Results.*—Out of the list of many high multiple correlations made with the twelve factors and the criterion, these nine were chosen. In making the choice we were guided by the concepts of

simplicity of test administration, and resulting useful information relative to the individual test.

TABLE 3

RESULTS OF MULTIPLE CORRELATION OF FACTORS WITH CRITERION

| | | | |
|---|---|---|---|
| 1. | Chinning strength — chinning p.f.i. | — motor quotient | $R = .916$ |
| 2. | Chinning strength — chinning p.f.i. | — general m.c. | $R = .900$ |
| 3. | Chinning strength — class. index | — motor quotient | $R = .887$ |
| 4. | Chinning strength — Rogers' p.f.i. | — class. index | $R = .886$ |
| 5. | Chinning strength — Brace test | — class. index | $R = .878$ |
| 6. | Number of chins — class. index | | $R = .862$ |
| 7. | Chinning strength — motor quotient | | $R = .854$ |
| 8. | Chinning strength — chinning p.f.i. | | $R = .848$ |
| 9. | Rogers' p.f.i. — strength index | | $R = .833$ |

When the combination of chinning strength, chinning physical fitness index, and the motor quotient is correlated with the criterion, a result of .916 is obtained. A score nearly as high results when general motor capacity is substituted for motor quotient in the combination, the multiple correlation of .900 resulting. Chinning strength, classification index, and motor quotient in combination give the results of .887.

It is significant to note that in these three combinations, which are highest in the list of multiple correlations, the tests involved require no special equipment, and relatively speaking, are easily administered and scored. The use of any of the combinations will also give the tester much of the valuable information desired about the boy. They have, therefore, much to recommend them as classifying devices.

For those who desire to use the Rogers test, the combination of chinning strength, Rogers' physical fitness index, and the classification index will provide a good classifying tool since it correlates .886 with the criterion. The combination of chinning strength, Brace test, and classification index is just about as good giving a correlation of .878.

In the two-factor combinations, that of number of chins and classification index which correlates .862 with the criterion is exceedingly easy to administer and score. This combination has the disadvantage of supplying very little information about the boy; however because of its simplicity of operation it would be preferred by many to other combinations. Chinning strength and motor quotient also make a very good combination for classifying, particularly since the latter factor makes available much information about the individual, involving as it does, age, weight, height, Brace test, Sargent jump, and the Burpee test.

Upon first thought these two-factor combinations appear to be just about as good for classifying purposes as those involving three items. However when we realize that they are about 20 per cent less efficient than the latter combinations, we are brought to appreciate the significance of a .05 difference in correlation, and the superiority of the three-factor combinations over the two.

In the last two combinations we note a situation which might at first appear to be unreasonable. Here we find the factors of chinning physical fitness index and the Rogers' physical fitness index which have very low correlation scores with the criterion,[5] combining with chinning strength and strength index respectively and raising the correlation of these two factors with the criterion appreciably. This is explained by the fact that these items measure different aspects of classification, substantiating evidence of which is found in the low intercorrelations[6] between the variables. When they are combined however they raise the multiple correlation. These combinations give very acceptable correlation results with the criterion though, and for those who want the information involved, may serve effectively as classifying devices.

*Simplified Regression Equations.*—The following regression equations which have been simplified for practical purposes are offered for use with the above classification devices.

TABLE 4

REGRESSION EQUATIONS SIMPLIFIED FOR PRACTICAL USE

1. Chinning strength — 1.4(chinning p.f.i.) + 5(motor quotient)
2. Chinning strength — 3(chinning p.f.i.) + g.m.c.
3. Chinning strength + 5(class. index) + 7(motor quotient)
4. Chinning strength + 2.7(Rogers' p.f.i.) + 5.7(class. index)
5. 9(chinning strength) + Brace + 2(class. index)
6. Number of chins + 2(class. index)
7. Chinning strength + 3(motor quotient)
8. Chinning strength — 1.7(chinning p.f.i.)
9. Rogers' strength index — 24.4(Rogers' p.f.i.)

Your attention is called to the fact, that in the first, second, eighth, and ninth of the equations we have a phenomenon for which we have no explanation to offer at the present time. In each of these formulas we have the classification score *reduced* by the existence of a high physical fitness index score. This does not seem to be a reasonable relationship, but nevertheless is a consistent result of the study. Further investigation in this matter may reveal the reason for these results.

In the use of these equations it is suggested that the pupils be scored on the tests involved, given a classification score by the formula used, and then divided into classes or sections to suit the local situation.

## CONCLUSIONS

1. It would appear from the correlations compiled in this study that the best single factor for classifying is our weighted strength index; however, viewed in the light of our criteria for a classifying device it would rank second to the *short strength test* which gives a correlation just about as high as does the weighted strength index, provides valuable

[5] See Table 2.

[6] See table of intercorrelations in the appendix.

information about the boy, and is characterized by the factors of economy in time and equipment.

2. The next best single factor would appear to be the *classification index*, determined by the formula 20(age) + 6(height) + weight. This device is simple and very easily administered but furnishes a minimum of other useful knowledge concerning the motor equipment of the boy.

3. Among the two-factor combination devices, primarily because of its simplicity, *number of chins and classification index* in combination, is to be preferred as a classifying tool.

4. The five factors, *chinning strength, chinning physical fitness index, motor quotient, classification index,* and *general motor capacity,* when used in the combinations given in Table 3 constitute the classification devices that correlate with the criterion the highest of all the factors studied.

Because of simplicity in administering and scoring, their informative nature, and the fact that they require no special equipment, these devices have much to recommend them as tools for classifying junior and senior high school boys in physical education.

## APPENDIX

*Factors used in correlations*

O. Criterion
S. Weighted strength index
M. Short strength index
1. Classification index
2. Strength index
3. Chinning strength
4. General motor capacity
5. Number of chins
6. Sargent jump
7. Brace test
8. Motor quotient
9. Chinning physical fitness index
C. Rogers' physical fitness index

*Simple correlations*

rOS — .888
rOM — .875
rO1 — .832
rO2 — .830
rO3 — .826
rO4 — .780
rO5 — .699
rO6 — .597
rO7 — .441
rO8 — .327
rO9 — .303
rOC — .245

*Intercorrelations*

r12 — .789
r13 — .860
r14 — .891
r15 — .628
r16 — .557
r17 — .313
r18 — .133
r19 — .457
r23 — .841
r24 — .858
r26 — .572
r34 — .764
r36 — .700
r37 — .290
r38 — .153
r39 — .560
r45 — .616
r48 — .508
r49 — .587
r67 — .100
r89 — .455
rC1 — .004
rC2 — .359
rC3 — .062
rC4 — .192
rC6 — .370
rC8 — .498

*Partial correlations*

$r_{01.3}$ — .424
$r_{03.1}$ — .389
$r_{0C.3}$ — .345
$r_{03.C}$ — .839
$r_{02.3}$ — .443
$r_{03.2}$ — .424
$r_{03.7}$ — .813
$r_{07.3}$ — .373
$r_{08.3}$ — .360
$r_{01.5}$ — .707
$r_{05.1}$ — .401
$r_{0C.2}$ — .—102
$r_{02.C}$ — .821
$r_{09.3}$ — .—344
$r_{03.9}$ — .832

*Multiple Correlations*

$R_{0.398}$ — .916
$R_{0.394}$ — .900
$R_{0.318}$ — .887
$R_{0.3C1}$ — .886
$R_{0.731}$ — .878
$R_{0.32}$ — .863
$R_{0.51}$ — .862
$R_{0.38}$ — .854
$R_{0.39}$ — .848
$R_{0.C2}$ — .833
$R_{0.73}$ — .853
$R_{0.31}$ — .860
$R_{0.3C}$ — .849

# A Further Study of Dysmenorrhea in College Women—University of Michigan

## (A Detailed Study of 1,550 College Women)

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DYSMENORRHEA is still an important problem. This is obvious when the recent literature is reviewed. Just how much this condition affects the success and happiness of women is an open question. The reports of clinicians dealing with this problem demonstrate that there are still, after all methods of therapy have been employed, some 6 to 10 per cent of all cases that do not respond to any form of treatment. Undoubtedly, the incidence of dysmenorrhea continues at a rate higher than usually reported.

Buerre de Boisment in 1842 reported 360 cases with 77 per cent incidence of dysmenorrhea; Sames in 1916 found dysmenorrhea in 47.4 per cent of 508 women observed; Clow in 1920 reported on 1,200 healthy girls and found only 27 per cent with painful menstruation. Miller in 1930 reported 47 per cent; Boynton in 1932 reported 20.38 per cent; and Lakeman (industrial), 1933—89.6 per cent.

In the following report about 1,550 cases of students have been carefully studied in detail in an effort to find the important factors bearing upon the high incidence of dysmenorrhea among young women of college age. The number of cases reviewed in detail was divided as follows:

TABLE I

| | |
|---|---|
| 269 | freshmen 1931 |
| 306 | freshmen 1932 |
| 800 | cases dysmenorrhea examined pelvically 1929–1933 |
| 1,375 | all students |
| 175 | students in physical education, 1923–1933 inclusive |
| 1,550 | total number of cases |

This study will necessarily be concerned with essential or primary dysmenorrhea, those cases in which no etiological factor could be found

in the pelvis. However, we will include the retroversions, acute anteflexions, and hypoplasias.

In 1929 the pelvic examinations in one hundred cases of severe pain showed the position of the uterus to be in the normal condition of anteflexion in 48 per cent, retroverted in 43 per cent, and abnormally anteflexed in 9 per cent. The rate of displacements found in the following years varied to 20 per cent. The average over a period of five years in eight hundred cases was 20 per cent.

Our recent studies show the following incidence and degree of pain. Pain was classified as follows: severe pain—in bed one day or more; moderate pain—in bed few hours to part of day; mild pain—includes slight pain, irregularly or consistently; no pain—at any time. (Amenorrhea—during residence.)

TABLE II

INCIDENCE OF DYSMENORRHEA

| | Freshmen 1931 | | | Freshmen 1932 | | | Students Physical Education 1923–1933 | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | Per Cent | | No. | Per Cent | | No. | Per Cent | |
| No pain | 27 | 10 | | 23 | 8 | | 94 | 53.71 | |
| Slight pain | 106 | 40 | 90% | 132 | 42 | 92% | 53 | 30.28 | 44% |
| Moderate pain | 82 | 30 | | 102 | 34 | | 19 | 10.85 | |
| Severe pain | 54 | 20 | | 49 | 16 | | 6 | 3.49 | |
| | 269 | 100 | | 306 | 100 | | 172 (3 amenorrhea) | 98.33 | |

In these comparisons, the high rate (90 and 92 per cent) of dysmenorrhea found among the general run of college women and 44 per cent found among those students specializing in physical education is to be accounted for by the fact that occasional pain during the period is included. The groups classified under the headings of "moderate" and "severe dysmenorrhea" probably correspond to the college groups usually reported as cases of periodic menstrual pain.

Results of college studies indicate certain trends: (1) that those reporting "no menstrual pain" on their original history will occasionally have pains during the period rating from mild discomfort to incapacitation; (2) that those originally reporting "no pain ever" will gradually acquire pain during their college years and it may become regular and severe; and (3) that there is a group reporting pain at the original examination which will show a decrease or no pain in the subsequent college years.

The following table shows the course of pain from year to year.

TABLE III

175 PHYSICAL EDUCATION STUDENTS, UNIVERSITY OF MICHIGAN, 1923–1933—COURSE OF DYSMENORRHEA DURING SERIES OF YEARS

| Degrees of Pain | 1st year | | 2nd year | | 3rd year | | 4th year | |
|---|---|---|---|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent | No. | Per Cent | No. | Per Cent |
| No pain ..... | 94 | 53 | 74 | 55 | 48 | 60 | 45 | 82 |
| Slight pain ..... | 53 | 30 | 36 | 27 | 21 | 26 | 7 | 13 |
| Moderate pain .. | 19 | 11 | 18 | 13 | 7 | 9 | 1 | 2 |
| Severe pain .... | 6 | 3 | 3 | 2 | 1 | 1 | 0 | 0 |
| Amenorrhea .... | 3 | 2 | 3 | 2 | 3 | 4 | 2 | 4 |
| | 175 | | 134 | | 80 | | 55 | |

TABLE IV

175 PHYSICAL EDUCATION STUDENTS, UNIVERSITY OF MICHIGAN, 1923–1933

| Includes all grades of pain, slight, moderate, and severe Per Cent | | Moderate and severe pain: (exclusive of slight pain) Per Cent | |
|---|---|---|---|
| 47 | Freshman year | 17 | Freshman year |
| 45 | Sophomore year | 18 | Sophomore year |
| 40 | Junior year | 14 | Junior year |
| 18 | Senior year | 5 | Senior year |

TABLE V

COMPARISON INCIDENCE OF PAIN, FRESHMAN AND SOPHOMORE CLASSES

| Degrees of Pain | 1932 | | | 1933 | |
|---|---|---|---|---|---|
| | No. | Per Cent | | No. | Per Cent |
| No pain ..... | 23 | 8 | | 33 | 13 |
| Mild pain ..... | 132 | 42 | | 91 | 48 |
| Moderate pain ..... | 102 | 34 | 92% | 52 | 28 |
| Severe pain ..... | 49 | 16 | | 11 | 11 |
| | 306 | 100 | | 187 | 100 |

The decrease in number of students who returned to college may account for the marked changes. Boynton in 1932 showed a marked increase (10 per cent) in the sophomore year; Scott of Smith College noted increases in the junior and senior years when physical exercise was decreased and the academic load was increased.

In the group of physical education students, the following changes in the incidence and intensity of pain were recorded. These students were participating in exercise of varying types and intensities at least twelve hours a week.

## THE AGE AT WHICH PAIN BEGAN

In 175 cases of students of physical education, 40 per cent had pain from the onset, while 60 per cent acquired pain after the first year. We

TABLE VI

175 PHYSICAL EDUCATION STUDENTS, UNIVERSITY OF MICHIGAN—STATUS CHANGES IN INTENSITY PAIN DURING RESIDENCE

| | No. | | Per Cent | |
|---|---|---|---|---|
| No change | 132 | 163 | 75.42 | 81% |
| Pain increasing | 12 | | 6.84 | 7% |
| Pain decreasing | 19 | | 10.87 | 2% |
| No record | 12 | | 6.84 | |
| | 175 | | 99.97 | |

have selected Table VII to illustrate this point. A review of our data both from the University and the University High School seems to confirm this trend.

## HEALTH EXAMINATIONS—HISTORIES AND CLINICAL CAUSES

In the main it can be said that the intensity and frequency of periodic pain varies directly with the general health of the student. The better the health, the less the pain. The pain is decreased with a general improvement in hygiene. When we compare the two groups, those showing no

TABLE VII

175 PHYSICAL EDUCATION STUDENTS, UNIVERSITY OF MICHIGAN—AGE AT WHICH PAIN BEGAN

| | No. | Per Cent | |
|---|---|---|---|
| With first period | 34 | 40. | |
| 15 years | 16 | 18.82 | |
| 16 years | 12 | 14.12 | |
| 17 years | 8 | 9.42 | |
| 18 years | 10 | 11.76 | 60% |
| 19 years | 2 | 2.35 | |
| 20 years | 1 | 1.18 | |
| 21 years | 2 | 2.35 | |
| | 85 | 100.00 | |

pain or slight pain with those showing moderate or severe pain or incapacitating pain, the following results are recorded at the beginning of the sophomore year.

*Histories Compared.*—That there are clearly defined differences to be found in the history of students having little or no menstrual pain and those having incapacitating pain is evident.

*Comparison of Family Health Record.*—The histories of the relatively healthy group revealed a lower incidence of nervous trouble, sick headaches, allergic conditions such as asthma, and hypertension among their progenitors.

*Comparison of the Personal Histories of Past Illnesses.*—The healthy group showed a definitely lower incidence of sore throat, tonsillitis, rheumatism, frequent head colds, urticaria, sick headaches, and constipa-

tion than did the incapacitated group. The healthy group reported definitely less fatigue, less nervousness, less tendency to worry than the incapacitated group.

Since a greater number of allergic conditions was reported in the incapacitated group, a more detailed study was tabulated.

*Comparison of Protein Sensitivity.*—Here the students were classified according to history as follows.

TABLE VIII

1932 Sensitization Grouping—History

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| X—No record | 3 | — | 1 | — |
| 1—Group I<br>Eczema<br>Rose fever<br>Hay fever<br>Asthma | 20 | 13 | 21 | 14 |
| 2—Group II<br>a) Urticaria<br>b) G.I. upsets, food idiosyncrasy | 30 | 20 | 37 | 25 |
| 3—Frequent colds, headache, etc., with good family history of sensitization | | | | |
| 3—Group III<br>G.I. upsets, food idiosyncrasy, frequent colds with *no* family history of sensitization | 8 | 5 | 5 | 3 |
| 4—Group IV<br>No symptoms, so far with good family history of sensitization | 42 | 28 | 47 | 31 |
| 5—Group V | 52 | 34 | 39 | 26 |
| | 155 | 100% | 150 | 99% |

The findings in both groups seem to run parallel and there seemed to be no wide variations.

The incapacitated group reported more loss of weight, chronic cough, exposure to tuberculosis in the family, chest pain, and palpitation twice or three times as often as the pain-free group. These cases are too few in

number to be of statistical significance even though our larger group comparison confirms these observations.

TABLE IX

FAMILY HISTORIES COMPARED OF FRESHMEN 1931 AND 1932

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Nervous trouble | 25 | 19 | 33 | 25 |
| Sick headaches | 29 | 22 | 47 | 35 |
| Asthma | 25 | 19 | 36 | 27 |
| Hypertension | 29 | 22 | 43 | 32 |

PAST ILLNESS (PERSONAL HISTORIES) FRESHMEN 1931 AND 1932

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Sore throats | 39 | 29 | 49 | 36 |
| Tonsillitis | 31 | 23 | 42 | 31 |
| Rheumatism | 2 | 1 | 4 | 3 |
| Head colds | 21 | 16 | 42 | 31 |
| Urticaria | 5 | 4 | 13 | 10 |
| Sick headaches | 3 | 2 | 17 | 12 |
| Constipation | 20 | 15 | 32 | 24 |
| Fatigue | 10 | 7 | 35 | 26 |
| Nervousness | 11 | 8 | 29 | 21 |
| Worry | 12 | 9 | 37 | 27 |
| Loss of weight | 4 | 3 | 9 | 7 |
| Chronic cough | 3 | 2 | 6 | 4 |
| Chest pain | 0 | 0 | 4 | 3 |
| Palpitation | 1 | 1 | 6 | 4 |

*Comparison in Regard to Participation in Sports.*—The healthy group reported a much higher percentage of participation in sports both indoors and outdoors and a greater aptitude and skill than group two, while group two reported a greater interest in reading and quiet recreation, as shown in Table X.

TABLE X

EXERCISE HISTORY 1932

| | No pain—mild pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Much | 41 | 27 | 36 | 24 |
| Average | 102 | 65 | 86 | 58 |
| Little | 13 | 8 | 26 | 17 |

When the effect of physical activity on the menstrual function was reviewed, we confirmed the fact that the large majority noted no changes of any type as a result of participating in sports of varying intensities.

There is a group ranging to at least 25 per cent in which suitable general exercise taken during the period has a decidedly beneficial result—the feeling of well being is promoted and pain is decreased.

There is a certain percentage of cases (from 12 per cent to 20 per cent) that is affected in a deleterious way by exercise, pain is increased, and the tendency to menorrhagia is increased. In addition to the group improved by regular activity of varying degrees there is a group that responds to special exercises directed to correction of pelvic circulation and abdominal strength. There are, in addition to these, those with displacement of the uterus, especially retroversion of the first and second degree, that are improved by special exercises. The retroversions of the third degree are not so readily affected, while new exercises for the replacement of acute anteflexion have been said to be effective. The following table has been selected to support this fact, which is confirmed by our other comparisons.

TABLE XI

175 Physical Education Students, University of Michigan, 1923–1933—Effects of Exercise Taken During the Period

| | | |
|---|---|---|
| No effect | 117 | 73 |
| Increases pain | 16 | 10 |
| Decreases pain | 19 | 12 |
| *Other symptoms | 8 | 5 |

*Success in Required Physical Education Compared.*—The physical education grade is a composite rating, taking into consideration natural ability and achievement and is not wholly satisfactory. The two groups have been rated by similar methods and the grades therefore are comparable.

TABLE XII

Freshmen 1932—306 Cases

First Semester

| Physical education grade | No pain–slight pain No. | Per Cent | Moderate pain–severe pain No. | Per Cent |
|---|---|---|---|---|
| A | 21 | 15 | 15 | 13 |
| B | 60 | 44 | 60 | 50 |
| C | 48 | 35 | 40 | 34 |
| D or E | 7 | 5 | 4 | 3 |
| | 136 | 99 | 129 | 100 |

Author's Note.—Fifty-one did not take physical education.

*Comparison in Regard to Student's Self-Health Rating.*—The healthy group reported a much higher rate of excellent health as shown in Table XIII. The better group had a history of 33 per cent less serious illness within the preceding two years.

*Other symptoms—backache, menorrhagia, decreases flow, stops flow, etc.

TABLE XIII

STUDENT'S OWN RATING OF PERSONAL HEALTH—FRESHMEN 1931, 268 CASES

| | No pain–mild pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Fair health | 4 | 3 | 12 | 8 |
| Good health | 62 | 47 | 80 | 59 |
| Excellent health | 66 | 50 | 44 | 32 |
| | 132 | | 136 | |

## COMPARISON OF MEDICAL EXAMINATION FINDINGS

*Comparison of the Height-Weight Ratios.*—The following table does not reveal any marked differences between the two groups. Other studies, notably Cunningham's, have shown the incapacitated group to be below the normal.

TABLE XIV

FRESHMEN WOMEN 1931, 266 CASES

HEIGHT-WEIGHT VARIATION

| | No pain–mild pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Normal—overweight to 20 per cent and underweight less than 10 per cent | 94 | 72 | 101 | 75 |
| Over average 20 per cent up | 5 | 4 | 4 | 3 |
| Below average 10 per cent or more | 32 | 25 | 30 | 22 |
| | 131 | 101 | 135 | 100 |

*Comparison of Posture Ratings.*—Table XV does not show enough difference between the two groups to either confirm or refute the apparent direct relationship shown between good posture and a high rate of menstrual dysmenorrhea function (the better the posture, the greater the pain) reported by Miller and Boynton separately, although such a comparison of the students of physical education did reënforce this impression. However, if poor posture is supposed to be an index of poor muscle tone and unsatisfactory physical condition, and dysmenorrhea is found in a higher percentage of cases in those of poor physical condition, we have a paradox. It would seem that we have not selected the proper factors for judging unsatisfactory posture.

*Comparison of Visual Acuity.*—The study of relatively small number of cases (269) agrees with the findings of Cunningham who found an increased amount of hyperopia in the dysmenorrheic group.

TABLE XV
FRESHMEN 1931 AND 1932—565 CASES
POSTURE RATINGS

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Excellent | 27 | 9.5 | 29 | 10+ |
| Good | 116 | 40. | 114 | 40. |
| Fair | 136 | 48. | 137 | 49. |
| Poor | 6 | 2. | 2 | 1. |
| | 285 | | 282 | |

*Comparison of Constitutional Type.*—In this study, the athletic type is found to have a definitely lower incidence of menstrual pain.

TABLE XVI
FRESHMEN 1931 AND 1932,
CONSTITUTIONAL TYPE

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| Asthenic | 59 | 25 | 75 | 27 |
| Athletic | 89 | 38 | 66 | 24 |
| Pyknic | 13 | 6— | 10 | 4— |
| Dysplastic | 1 | — | 0 | — |
| Mixed | 72 | 31 | 128 | 46 |
| | 234 | | 279 | |

*Comparison of Condition of Nose, Throat, Ears, and Tonsils.*—No marked difference was noted between the two groups.

*Comparison of Teeth.*—More carious teeth were found among the healthy group.

*Comparison of All Skin Conditions.*—Our data does not show a higher incidence of acne among the incapacitated group but in contrast

TABLE XVII
FRESHMEN 1931—269 CASES
PULSE RATE

| Pulse Rate | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| 69 or below | 17 | 13 | 19 | 14 |
| 70–89 | 96 | 72 | 99 | 74 |
| 90 and above | 20 | 15 | 18 | 13+ |
| | 133 | | 136 | |

shows a higher percentage of skin conditions of all types among the healthy group.

*Pulse Rate Comparison.*—See Table XVII on page 57.

*Blood Pressure Comparison.*—Showed no difference in the two groups with a systolic under 120. The cases above 120 showed a lower incidence of dysmenorrhea. When pulse pressure was considered, no important differences were shown.

TABLE XVIII
FRESHMEN 1931—268 CASES
BLOOD PRESSURE

| Systolic | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| 109 or below | 20 | 14 | 27 | 19 |
| 110–129 | 95 | 72 | 93 | 69 |
| 130 up | 18 | 14 | 15 | 12 |
| | 133 | 100 | 135 | 100 |

*Functional and Organic Heart Disease.*—It was found more often in the incapacitated group. However, the number of cases is too small to be of statistical significance.

*Laboratory Findings.*—Hemaglobin (Talquist), urine for sugar and blood, and temperature tests showed no important differences between the two groups. A more detailed study of the hemaglobin content done by the Sahli method indicates a higher incidence of anemia in the incapacitated group.

*Final Diagnoses.*—The incapacitated group revealed more pathology in eye, ear, nose, throat, heart, lungs, displacement of the uterus, pelvic pathology, and gastro-intestinal conditions. The healthy group showed more cases to be 20 per cent or more overweight, a larger number of carious teeth and a higher percentage of positive Mantoux tests, and more cases set aside for chest observation.

Comparing number of dispensary calls, room calls, and infirmary and hospital days, the number of hospital and infirmary days was three times greater for the dysmenorrhea students. One class showed consistently larger numbers of dispensary calls, room calls, and respiratory infections also for this group. In another class the hospital and infirmary days gave the only significantly different numbers for these items.

Since so marked a difference was noted between the groups in the number of psychoneurotic symptoms reported, we compared the mental hygiene ratings, the number of clinical mental hygiene cases, the ratings resulting from the American Council of Education on freshmen psychological tests, and the academic grades both at the end of the first and

second semester but no significant difference between the two groups was noted.

*Comparison of Mental Hygiene Rating.*—The Mental Hygiene Department holds an interview with each student during the entering examination. As a result of this interview, the student is placed in one of four groups according to personality, integration, and adjustment.

TABLE XIX

MENTAL HYGIENE RATINGS, 306 FRESHMEN, 1932

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| A—Excellent | 11 | 8 | 5 | 4 |
| B—Good | 100 | 71 | 90 | 68 |
| C—Fair | 30 | 21 | 36 | 27 |
| D, E—Poor | 0 | 0 | 2 | 1 |
| No record | 14 | | 18 | |
| | 155 | 100 | 151 | 100 |

This relationship interested us especially for it is a well recognized fact that psychic and emotional disturbances aggravate or instigate menstrual pain. No marked variations are seen in the two groups.

The next table is concerned with those students who subsequently came to the Mental Hygiene Department as clinical cases. No marked differences between the two groups is demonstrable here.

TABLE XX

CLINICAL CASES, MENTAL HYGIENE, 309 FRESHMEN, 1932

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| X. No clinical care | 129 | 80 | 125 | 78 |
| 1. Disturbance of actually psychotic type | 0 | | 0 | |
| 2. Disturbance based on various organic conditions and special defects | 0 | | 1 | |
| 3. Acute "nervous" conditions, mild to moderate in degree | 7 | 4+ | 10 | 6 |
| 4. Problems of general personality adjustment of various degree | 24 | 15 | 23 | 14+ |
| | 160 | | 159 | |

*Comparison on Basis of Psychological Tests.*—During Orientation Week, all freshmen were given a psychological test of the American Council of Education. The results were classified into quartiles that indicate the status of the individual. No significant differences were noted in comparing the results from both groups as given in Table XXI.

TABLE XXI

RESULTS OF PSYCHOLOGICAL TESTS, 306 FRESHMEN, 1932

| | No pain–slight pain | | Moderate pain–severe pain | |
|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent |
| 0 | 1 | 1 | | |
| 176 and over | 28 | 19 | 23 | 16 |
| 149–176 | 42 | 28 | 37 | 26 |
| 116–148 | 37 | 25 | 38 | 27 |
| 0–115 | 42 | 28 | 44 | 31 |
| No record | 5 | | 9 | |
| | 155 | 100 | 151 | 100 |

Ratings divided in quartiles—quartile 1, lowest; quartile 4, highest ranks.

*Comparison of Academic Loads and Work for Pay.*—When these groups were compared on the basis of those carrying a heavier than average academic load, and on the basis of hours of outside work for pay, the tabulations showed no important differences so are not included.

## DISCUSSION

Dysmenorrhea is a symptom that arises from a disturbance of the contractions of the uterus. The uterine motility may be affected by stimuli that come through the higher centers of the cerebrum, through the vegetative nervous system by way of the presacral nerves, or from the pelvic cervical ganglia. The immediate mechanism which stimulates these cramp-like pains is not so easily explained. Constitutional factors and psychogenic factors are recognized in the explanation of these. All that is now known in the field of psychiatry and endocrinology leaves us without the answer. A large group is relieved of pain through psychotherapy and other constitutional measures.

Endocrine therapy directed to the anterior pituitary and the ovary, and secondarily to the thyroid and possibly even to the adrenal, will relieve a large proportion of cases.

The course which the physical educator might follow to advantage should be to educate the parent to begin the sex education of the child at a suitable age for too early a discussion of these matters may be as disastrous as information that comes too late. Education poorly and in-

accurately given especially when it is colored by an unfortunate history of dysmenorrhea in the forebearers is fatal. The subject must be presented as a healthy phenomenon that reassures the girl in the dignity and place of women in society. Certainly every effort should be made to avoid the implication that pain or even periodic discomfort is to be expected. The child should be encouraged to carry on her routine—sports, bathing, etc., as usual.

Exercise has long been recognized as a curative measure in the large percentage of these cases. It probably carries direct psychological reassurance of normalcy in addition to its direct physiological effect.

If the psychogenic factors account for the large percentage of dysmenorrhea reported here, it seems inconsistent that 73 per cent of this group reported no deleterious effects from exercise taken during the period.

Corrective exercises directed at the correction of malpositions of the uterus and to the strengthening of weak abdominal muscles, and the correction of sluggish pelvic circulation are often specific in their effect. General exercise taken at frequent regular intervals is effective both as a preventive and a cure.

## SUMMARY

1. When all grades of pain from mild to severe are included, dysmenorrhea is found in 91 per cent of 575 freshman women while 44 per cent of this pain is of incapacitating character.

2. A certain group seem to outgrow an adolescent dysmenorrhea, while another group acquire menstrual pain with increasing maturity.

3. In 40 per cent of cases, pain began with first period.

4. The incidence of dysmenorrhea was greater in those having—

*a*) A family history of nervous disease, hypertension and allergy.

*b*) A personal history of frequent upper respiratory infections, nervous instability, allergic conditions, and fatigue.

*c*) A personal history of such symptoms as loss of weight, constipation, chronic cough, chest pain, and palpitation.

*d*) A low rate of inclination and a low rate of actual participation in sport.

5. Exercise taken during the period had no effect in 73 per cent of cases; in 12 per cent of cases pain was definitely decreased. Exercise increased the pain in 10 per cent of cases.

6. Required physical education grades were not influenced by dysmenorrhea.

7. Those having incapacitating dysmenorrhea considered their general health to be inferior to those having no pain or slight pain.

8. Comparison of height-weight ratios did not bring out the fact that incapacitating dysmenorrhea is accompanied by underweight.

9. The supposedly better posture was found in the incapacitated group.

10. The asthenic and mixed constitutional types had a higher percentage of moderate and severe pain than did those of the athletic or pyknic types.

11. Pulse rates—comparisons were indecisive as were laboratory tests.

12. Functional and organic heart disease was found more often in incapacitated group.

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# The Relationship of Measurements of General Motor Capacity to the Learning of Specific Psycho-Motor Skills*

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## THE PROBLEM

THE problem was to determine the relationship of a battery of tests measuring general motor capacity and general motor ability to the learning of specific motor skills taught in physical education classes. The relationship was to be used for the purpose of classifying college students in physical education.

*Purpose of the Study.*—The purpose of this research was to determine the possible capacities, abilities, and motor educability of the individual students and to show the present attainments of those students. This information will enable the teacher to:

1. Test the validity and reliability of the relationship of the tests to the activities taught.
2. Classify the students and arrange a program which will satisfy and meet the needs of the members in each classification.
3. Devise a satisfactory method of grading students in physical education according to their ability and accomplishments.
4. Present to the students a desirable method of motivation.

*The Subjects Used.*—The subjects included in this research were the members of freshman class which entered the University of Virginia in the fall of 1932.

The school year at the University of Virginia is divided into three quarters. In each quarter three optional courses in physical education are offered. Only these courses and freshman sports for the first and second terms were used in this problem.

The entire first week of scheduled classes in physical education, which consisted of three class meetings of forty-five minutes each, was taken to administer two batteries of tests. These tests were to determine each student's general motor capacity and his general motor ability.

*Digest of a Master's Thesis, University of Iowa, 1933.

All freshmen who were physically able to participate in physical education classes were given the tests, but the final number of subjects was considerably less due to withdrawals and suspensions.

*Equipment Utilized.*—The materials used for administering the tests were as follows: standard scales, height standard, hand dynamometer, back and leg dynamometer, jump meter, horizontal bar, parallel bars, twelve-pound shot, mats, jump standards, stop watch, and starting pistol.

## THE TESTS

### I. THE GENERAL MOTOR CAPACITY TEST[1]

This test is made up of the following individual tests:

1. *The Classification Index.*—This index is computed by the following formula:

20 (age in years) + 6 (height in inches) + (weight in lbs.)

(Age does not increase further than seventeen. Ages of seventeen and above are considered as seventeen.)

2. *The Modified Brace Test.*—The original Brace test consisted of twenty individual stunts. In the modification of this test some of the original stunts were eliminated and others added; the total number is now twenty-four (revision of 1932). The modified test is given in two batteries, each containing twelve stunts.

Instructions for administering this test may be found in *Measuring Motor Ability.*[2]

Tables for this test were made by the T-score method.

3. *The Sargent Jump.*—The jumps were recorded on a Sargent jump meter which records in centimeters.

4. *The Burpee Test (10 Seconds).*[3]—The above tests were combined to arrive at the general motor capacity by the following formula:

.187 (Classification index) +.823 (Sargent jump in centimeters) +.526 (Brace test) +2.26 (Burpee test) —182.

### II. THE GENERAL MOTOR ABILITY TEST

1. *Weighted Strength Index.*—

1 (right grip) +1 (left grip) +2 (chinning strength) +1 (dipping strength) +0.1 (back lift) +0.1 (leg lift) —3 (weight).[4]

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[1] C. H. McCloy, A Tentative Classifying and Grading System for Physical Education Based on Measurements of Motor Ability. Unpublished mimeograph material, State University of Iowa. 1932. This test has been revised and is now available at the State University of Iowa under the title of "The Measurement of General Motor Capacity."

[2] D. K. Brace, *Measuring Motor Ability,* pp. 105-124. New York: A. S. Barnes and Company.

[3] The Burpee test throughout the remainder of this manuscript will be referred to as the Burpee "10."

[4] C. H. McCloy, Unpublished paper. State University of Iowa.

The chinning strength and the dipping strength are found by the following formulae:

1.77 (weight) —46+3.42 (number of chins)[5]
1.77 (weight) —46+3.42 (number of dips)[5]

2. *The Track Test.*—This test is made up of the following four track and field events:

1. 60-yard dash
2. Running high jump
3. Standing broad jump
4. 12-pound shot

The scores for the track events were converted by the use of tables[6] to obtain the final track score.

The weighted strength index score found by the above formula was multiplied by .0772 and the result obtained was added to the converted score for the track and field events. From this, 41 was subtracted and the result was the general motor ability index.

This battery, as in the case of general motor capacity, does not test for any specific skill but merely for general motor ability in executing motor skills.[7]

## COURSES TAUGHT IN PHYSICAL EDUCATION CLASSES

Only those courses taught during the first two terms of the school year were used in this study for correlation with the general motor capacity and the general motor ability tests. They are listed here:

1. Touch football (fall term)
2. Individual activities (fall term)
3. Beginning swimming (fall term)
4. Basketball (winter term)
5. Handball (winter term)
6. Boxing (winter term)
7. Tap dancing (winter term)

These term courses, with the exception of Beginning Swimming, were optional to the students. The entire freshman class was given a swimming test and those men incapable of swimming fifty yards free style were signed for Beginning Swimming. There were no tests of classification given, other than the one stated above.

## COURSE CONTENTS, REQUIREMENTS, AND METHOD OF T-SCORING FOR CORRELATION WITH THE ABILITY AND THE CAPACITY TESTS

1. *Touch Football.*—The content of this course consisted of the fundamental skills of the game, i.e., passing, catching, punting, drop kicking, snapping the ball from center, and carrying the ball. In addition to the fundamentals, team play, rules, sportsmanship, and plays were taught.

[5] C. H. McCloy, *The Measurement of General Motor Capacity.* Iowa City: State University of Iowa. Copyright 1933.

[6] C. H. McCloy, *The Measurement of Athletic Power.* p. 166. New York: A. S. Barnes and Company, 1932.

[7] The weight strength index was used in place of the chinning strength alone.

At the conclusion of the term a practical test was given in fundamentals, which included the following: passing thirty yards, passing for accuracy by successfully getting the ball to a man in motion (one out of three trials), three accurate center snaps of fifteen yards, three accurate center snaps of twenty yards, one successful drop kick out of three from the twenty-yard line, and a punt of thirty-five yards (three trials allowed).

The scores for the members of all touch football classes were put together and T-scored.[8] A rating scale was arranged and each instructor rated his class members on their ability to play touch football. The scores were assigned according to the following scale:

1. Very poor
2. Poor
3. Little below average
4. Average
5. Little above average
6. Good
7. Very good[9]

Each student's T-score for fundamentals and T-score for ratings were added together and divided by two to obtain the final T-score for his ability in touch football.

2. *Individual Activities.*—There are fifteen individual stunts in this course. Each one of them was taken up at one class period for group instruction. The stunt was demonstrated in part and then as a complete movement. At the same time correct positions and coordinated movements, as well as false movements which should be avoided, were pointed out for the purpose of enabling the student to make correct executions of the stunts.

When all the stunts had been presented in the above manner, the class members were permitted to practice them in the order they desired. While this was being done the instructor gave individual instruction where it was most needed or where it was requested by a student.

Below is the list of stunts in the order they were presented to the class, with the passing requirement for each.

1. Rope skipping (125 times in a minute)
2. Chinning (10 times)
3. Floor dips (20 times)
4. Sit ups (20 times)
5. Bar vault (height of student's chin)
6. Rope climb (22 feet in 12 seconds)
7. Standing broad jump (height of student plus 2 feet)
8. One lap run, indoor track (one-twelfth of a mile in 21 seconds)
9. Springboard high jump (height of the student)
10. Obstacle race (12 seconds)
11. Pirouette (one complete turn and retain the balance)
12. Sky jump (height of student plus two feet)
13. Bar snap (distance equal to student's height)
14. Hitch kick (height of student plus two feet)
15. Pulley weights (correct demonstration of seven given exercises).

[8] W. A. McCall, *How to Measure in Education*, pp. 249-271. New York: Macmillan Company, 1922.

[9] This same rating scale was used throughout the remainder of the study.

At the close of the term a test was given in each of the fifteen stunts and individual students were graded on each stunt by the "pass" or "fail" method. The records for the students in all sections of the course were put together and T-scores made for them.

3. *Beginning Swimming.*—This course was for all students who were unable to swim a distance of fifty yards free style. The initial problem in this course was to teach each student to swim. After this task was completed, seven simple water stunts were taught to the class. Of course, some of the students learned to swim very quickly while others were slower in learning. As a result, a great deal more time was given to the practicing of the stunts for some of the class members than for others.

The water stunts offered were as follows:

1. Floating for thirty seconds
2. Sculling across the pool (thirty-five feet)
3. Surface dive and retrieve an object in six feet of water
4. Bobbing for thirty seconds at the deep end of the pool
5. Plain front dive from the edge of the board without a spring
6. Arching-back back dive from the board without a spring
7. Treading water for thirty seconds

At the conclusion of the course each student was given a test on each of the above water stunts. He was given three trials for each stunt. They were graded by the "pass" or "fail" method. In addition to these tests, the students were given a swimming test in which each man swam as far as he could. This distance was measured in feet. The records obtained for the water stunts for all the sections in beginning swimming were put together and T-scores made.

Likewise, the results for the tests in the swim for distance were assembled and T-scored. Then each subject's two T-scores were added together and divided by two to arrive at his final T-score for the course. This final score was used in the correlations.

4. *Basketball.*—The class work in basketball consisted of demonstration and teaching of the fundamentals of the game, such as: passing, receiving, short shots, long shots, dribbling, stops, turns, and pivots. In addition to the fundamentals, individual and team defensive and offensive playing were stressed. Considerable time was given to the playing of the game. Each student was expected to have a complete knowledge of the rules of basketball. At the close of the term each student in the class was given a rating by the instructor for each of the following four items: shooting, passing and receiving, basketball speed, and general all-round ability to play basketball.

Scores for all sections in basketball were assembled and T-scores made for each of the four items. Each student's four T-scores were added together and divided by four to obtain his final T-score for basketball.

5. *Handball.*—The course offered in handball consisted of instruction in the fundamentals of the game, which were as follows: stance for serv-

ice, swing, placing the serve, position on the court, underhand swing, side-arm swing, and overhand swing for both the left and right hands.

Instructions were given on covering the court in both singles and doubles. Each class member was expected to have a complete knowledge of the rules. Approximately half of the class period was spent in the actual playing of the game, during which time the instructor made corrections of errors as they appeared.

At the end of the course a practical test was given on the fundamentals to determine each individual's term grade. While this procedure was in progress the instructor made three ratings for each member on the following three items: service, returning the service, and general all-round ability.

The ratings for the three items were collected from all sections and assembled in their respective groups. Each of the three groups was then T-scored. Each subject's three T-scores were added and the total divided by three for his final T-score for handball.

6. *Boxing.*—Instruction in the fundamentals of boxing was given to the members of the class in boxing. The fundamentals were: on-guard position, foot work, making a fist, all blows for both the left and the right hands, the defense for each hand, blocking, and the snap away. Instruction was given in ringmanship and sportsmanship; each student was required to know all the rules. From eight to ten minutes were taken each day for actual boxing. The remainder of the class period was taken up with instruction, practice, and conditioning.

At the conclusion of the course each student was paired with a classmate of approximately the same weight and boxing ability, for a regular three-round bout. During the progress of the bouts the instructor rated each student on each of the three following items: offense, defense, and all-round ability and ringmanship.

Each student's ratings were added together and T-scored.

7. *Tap Dancing.*—This course consisted of the elementary fundamental steps and routines in waltz time. The class was instructed in the fundamental steps without music. Later the steps were put to music for short routines.

At the close of the term the instructor was given a list of the members of the class who were to be rated and asked to rate them by number. These ratings were then converted into T-scores.

*Freshman Varsity Sports.*—All freshmen varsity sports candidates were excused from their classes in physical education, but as soon as the squads were cut, men included in the cut immediately reported back to their regular physical education classes. These men are included in the class scores used in this problem. Those men remaining on the squad are included in the freshman sports. These sports were:

1. Football (fall term)
2. Boxing (winter term)
3. Indoor track (winter term)
4. Swimming (winter term)

At the end of the season for each sport the coach in charge was presented with a list of men on his squad who were included in the study and requested to make a rating of each man according to his ability in that sport. The same rating scale was used for the sports as was used above for the class courses. The coach was instructed to rate his team members on ability, only, irrespective of effort. He was requested to rate a squad member "7" (very good) only when he considered him of all-American calibre.

The ratings on each sport were assembled and T-scored to be used for correlation purposes.

In each of the courses and in freshman varsity sports the records of some of the students were incomplete due to illness, injury, or withdrawal or suspension from the University. These records were discarded and were not considered in this study. Only complete records were used.

## CORRELATIONS

All of the courses taught in physical education classes and all freshman varsity sports were used in the correlations with the tests given.

The activities and sports with the number of cases in each were:

1. Touch football ..... 106
2. Individual activities ..... 91
3. Beginning swimming ..... 25
4. Freshman football ..... 37
5. Basketball ..... 71
6. Boxing ..... 49
7. Handball ..... 43
8. Tap dancing ..... 25
9. Freshman boxing ..... 39
10. Freshman track ..... 17
11. Freshman swimming ..... 16

The results of these correlations are found in *Table I* of this paper.

## CONCLUSIONS

Most of the correlations are lower than was expected, especially after studying the results of other problems in which the *same* objective tests were used for correlations with similar activities. The following reasons and explanations partially account for these relatively low correlations:

1. All of the scores for varsity sports and for a number of class activities were obtained by the rating-scale method. A number of different coaches and teachers participated in the ratings.

Rudolph Pintner in his book *Intelligence Testing*[10] points out that there is a relatively high correlation between objective intelligence tests and objective achievement tests, while on the other hand there is a relatively low correlation between objective tests and teachers' subjective ratings. This truth is probably applicable here. Had all ratings in this

[10] Rudolph Pintner, *Intelligence Testing*. Chapter 4, pp. 44-99. New York: Henry Holt and Company, 1931.

## TABLE I
### Correlations

| | Number of Cases | G.M.C. | Sargent Jump | Burpee 10 | Modified Brace | Classification Index | First G.M.A. | First Strength Index | First Track | Second G.M.A. | Second Strength Index | Second Track | Improvement in G.M.A. (All Cases) | Improvement in Strength Index (All Cases) | Improvement in Track (All Cases) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Touch Football | 106 | .4439 | .2586 | .0521 | .4320 | —.0097 | .4976 | .1879 | .4912 | | | | | | |
| Individual Activities | 91 | .4001 | .4216 | .0613 | .4255 | —.0689 | .5019 | .2503 | .5366 | | .2564 | | | | |
| Beginning Swimming | 25 | .0301 | —.1735 | .1623 | .1454 | —.3845 | —.0851 | | .0413 | —.0174 | | | | | |
| Freshman Football | 37 | .2960 | .2377 | .2847 | .1778 | .1156 | .3605 | .2845 | .2920 | | | | | | |
| Basketball | 71 | .2434 | .1325 | —.002693 | .3534 | —.0999 | | .2407 | .5776 | .4886 | .07412 | .5528 | | | |
| Boxing | 49 | .2577 | .2994 | .0051 | .09082 | .4330 | .2465 | .1569 | .2394 | | .2648 | | | | |
| Handball | 43 | .1790 | —.1463 | .0013 | .4010 | .1946 | .3134 | .2650 | .3021 | | .2003 | | | | |
| Tap Dancing | 25 | .2941 | .1697 | .02212 | .3487 | .0061 | .2720 | —.1337 | .3535 | | | | | | |
| Freshman Boxing | 39 | .1488 | .2875 | .3293 | .1716 | —.3312 | —.0211 | —.01179 | —.0059 | | | | | | |
| Freshman Swimming | 16 | .5659 | .6176 | .3055 | | .2956 | .7031 | .5737 | .7282 | .5838 | | | | | |
| Freshman Track | 17 | .4537 | .4416 | .4683 | .3068 | .2494 | .7045 | .5359 | .7107 | | .3856 | | | | |
| Improvement in G.M.A. | All Cases | .03018 | .04894 | .01895 | —.002341 | .01691 | | —.0732 | | | | | | .4448 | .5963 |
| Improvement in Strength Index | All Cases | .01223 | | | | —.0337 | | —.3407 | | | | | | | .1070 |
| Improvement in Track | All Cases | —.04117 | | | —.03993 | | | .03939 | | | | | | | |

problem been made by one person, the possibilities are that many of of the correlations would be higher. There seems to be a tendency in rating for an instructor, or coach, to allow factors other than achievement to enter in, e.g., effort, class attitude, interest, and personal prejudices.

2. Correlations were made between some of the objective tests to aid in proving that the ratings made were probably slightly erroneous.

The correlation between general motor capacity and the first track test was .6286. The general motor capacity with general motor ability was .6588.

This indicates that the ratings for freshman track were slightly off, for the correlation between G. M. C. and freshman track was .4537. The form element in this rating probably affected the judgment of the rater.

The correlation of the two objective tests, motor ability and motor capacity, is relatively higher than the correlations of objective tests with ratings of achievement.

3. In some of the activities giving low correlations factors other than strength, power, endurance, agility, and educability are involved. In beginning swimming, for example, there are the intangible elements of courage and self-confidence.

4. Small samplings, as in tap dancing, freshman track, and freshman swimming may account for unexpected low or high correlations.

The two individual tests in which we find the highest correlations are the modified Brace (motor educability) and track.

A good score in track appears to be a good measure for general athletic ability.

Strength is of little significance to the activities in this study with the exception of track and freshman swimming, the latter of which is difficult to explain.

Age, height, and weight appear to be of little significance in practically all cases. This indicates that the *small clever* individual has an equal chance with the larger individual in the sports studied here.

It would seem that the Burpee test (agility) should play a more important rôle in relation with basketball, boxing, and tap dancing. The Sargent jump (a test of horsepower) applies more to activities of an individual nature than to group sports.

The consistency of relatively high correlations with freshman swimming as compared to the other activities is confusing. In swimming, rhythm and form are thought to be of greater importance than speed, endurance, and power.

It is the author's conclusion that the next step to be taken to improve other relationship studies of this type is to draw up standard objective tests in all sports and activities in order to eliminate all ratings, which, without a doubt, are inaccurate measurements of achievement.

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# The Influence of Exercise on the Rate of Passage of Inert Material Through the Digestive Tract

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EXERCISE has been long accepted as an integral part of the régime advocated for the cure and prevention of constipation. It is universally recommended as a prophylactic or therapeutic agent in the numerous monographs of the present century dealing with the physiology and pathology of the gastro-intestinal tract.*[1] With the exception of the recent work of Deaver[2] and of DeYoung, Rice, and Steinhaus,[3] a search of the literature failed to bring to light experimental verification of the influence of exercise upon the rate of intestinal evacuation. The empirical evidence covering many decades of clinical experience is of course invaluable. Exercise is medically never recommended alone, being associated with dietary advice and instruction concerning proper habit formation. The variable mechanisms explaining the apparent good effect of exercise led to this objective study. Aside from its general hygienic effect, the basis most frequently given for the recommendation is the strengthening consequence of exercise upon the voluntary muscles of defecation, the abdominals in particular. A taunt anterior wall permits a greater increase in intra-abdominal pressure, thus assisting in the expulsion of colonic residues. However the fact that great stress is often laid upon outdoor, generalized activity in preference to what seems more logical, specific abdominal exercise, led us further to speculate upon its probable effects. It has even been specified that the muscular activity be pleasurable, carried on with cheerful companions, wholly dissociated from occupation and worry.[4] Other paradoxical statements concerning this panacea are illuminating, such as reference to the resistant constipation not infrequently met with in the physically active and in the athlete.[5] If exercise does possess the rôle of preventive and corrective, its influence upon the motor power of the normal alimentary tract should be demonstrable.

## METHODS

*Criteria of Intestinal Function.*—The simplest objective criterion of intestinal function used by Burnett,[6] and Cowgill, Anderson, and Sullivan,[7] is the form and consistency of the dejecta. Cowgill and Anderson[8]

*Numbers refer to bibliography at end of article.

measured the weight, water, and fibre content of the evacuated residues and the rate of laxation. The stool may be marked off with carmine or charcoal. Burnett[9] administered and recovered millet seeds; Alvarez and Freedlander[10] used glass beads; and Hoelzel[11] studied the rate of passage of a variety of other inert and indigestible substances. The controversial investigations of Alvarez and Freedlander and of Hoelzel have served to demonstrate glass beads as an inert material lending itself to intimate admixture with the food eaten and to satisfactory quantitive measure. Apparently the beads in no way affect the motor power of the intestine. They are passed along about 60 per cent more slowly than normal food residues, because, according to Hoelzel, of their higher specific gravity, heavier materials moving more slowly. Hoelzel's published data show that glass beads administered along with inert material more like ordinary food residues in behavior do not delay the initial appearance of the latter. He also found that heavy test materials disclose variations in motility more easily than light ones.

It seemed, therefore, in no way illogical to select glass beads as the primary criterion for the study of the motor power of the gastro-intestinal tract and the influence of exercise upon it. A modification of the original Alvarez and Freedlander technique was used. Fifty glass beads two mm. in diameter were administered with the evening meal. For the early experiments they were given on four days. It was found that a small percentage of them often lingered in the intestine as long as five or six days. Since it was desired to make continuous observations, beads of six different colors were eaten on as many consecutive days. This group of six was considered a series at the end of which the first color might be readministered. Beginning the morning after the first beads were taken, all feces were individually collected in wide-mouth jars, were weighed, and then sieved separately for the recovery of the beads. The number of hours elapsing between the administration of the inert material and the appearance of the initial beads, 25, 50, 75 per cent, and the final or total recovery were noted. Incidental objective data included the weight of each excrement, weight of the feces eliminated in twenty-four hours, time interval between defecations, and number of bowel movements per diem.

*Subjects of the Investigation.*—Nine healthy young adult women with normal gastro-intestinal function acted as subjects. None could be classified as strictly sedentary. The physical activity normally carried on varied from that incidental to walking to and from university classes on a hilly campus to regular participation in sports. Five were professional students in physical education, upperclassmen leading a moderately active life, not more than two hours daily being usually devoted to sport or gymnastic activities. Rather than divide the subjects according to their activity habits, they were classified by their normal intestinal motor power.

*Exercises Studied.*—Numerous exercises have been recommended for constipation. These may be divided into sports, and into generalized and

specific activities involving predominantly the abdominal musculature. The majority of our observations were confined to the last named because of economy, ease, and uniformity of administration. Many of the abdominal exercises recommended were too simple and mild for the skill and strength of the group studied. The most difficult of those described were therefore adopted. They were carried on in a supine position, and for the development of the recti, consisted of double knee lifting to the chest with straightening and slow lowering; for the obliques, double toe touching to alternate sides with hips flexed and knees extended.

The exercises were prescribed for no set number of times, the subject changing from one to the other as the muscle groups tired. The effort was continuous for ten minutes. There were some complaints of muscles soreness. Severe localized exercise cannot be long continued and it is common practice to prescribe it in relatively short doses. The routine physical activity was controlled as much as practicable. Two ten-minute periods of abdominal exercise were superimposed upon the usual activity and were carried out upon rising in the morning and before bedtime. Their effectiveness was checked by measuring their influence upon the strength of the abdominal muscles, using a modification of the method of Hamer and Denniston.[12] Because of the popular interest in stationary rowing machines as corrective instruments in constipation, one study was made of the effect of ten-minute bouts of such exercise performed twice daily. The influence of one generalized exercise was also investigated. Two subjects who participated in no other sports during the experimental weeks played tennis for one hour daily during the period of observation.

*Plan of the Experiment.*—The rate of transmission of a minimum of two series of beads was taken as the normal standard for comparison. Keeping the activity and dietary régime as uniform as possible, the test exercise was instituted without break in the continuity of the observations until at least two more series of beads had been taken. During the five- or six-day interval between the swallowing and evacuation of the last fifty beads of the final series the standard routine was continued, to keep constant the number of beads traveling through the intestine.

## RESULTS

This study represents a total period of 335 days, during which time some 400 collections of feces were examined by one of us (M.M.M.) and more than 17,000 beads were administered and recovered. The shortest experimental periods averaged 30 consecutive days and the longest, 4 months of continuous observation. The subjects were arbitrarily grouped according to the average rate of passage of the majority of the beads given in the series comprising the normal observations. The recovery of 75 per cent of the beads was chosen because it represents the passage of the bulk of the test material administered. The initial appearance of the beads given on consecutive days is somewhat influenced by what Alvarez and

Freedlander call the "catching up phenomenon," whereas the recovery of the last few beads may be accidentally so delayed as to distort the picture of motor power thus given. The comparative rates of passage were called *rapid, intermediate,* and *slow.* They equalled 61, 70, and 84 hours respectively.

The division is somewhat artificial because the difference in rate between the rapid and intermediate groups is not, statistically, completely reliable. It is completely reliable between the rapid and the slow, and the intermediate and the slow, the critical ratio being 5.83 in the former and 3.39 in the latter. However, the division is maintained in spite of a critical ratio of 2.71, in which case the chances are 99.7 to 100 that the true difference is greater than zero and the ratio is 90 per cent of what it should be in order to insure a difference always greater than zero. All of the data falling into this group were obtained by one of us (M.M.M.) during 115 consecutive days of observation under the most ideal experimental conditions attained. The occupation of the subject imposed greater regularity and similarity in the daily activity than possible in the remaining members of the experimental group. The subject ate 2 meals in the laboratory for 3 months, during which time the breakfasts and luncheons were identical, and the dinners were very similar. The roughage intake was constant. The average rate of laxation was higher, the weight of the feces per day was greater, and the interval between defecations was shorter than that observed in the intermediate group. It is upon this supplementary evidence that the division is maintained. A summary of the data comprising the normal standards for comparison is recorded in Table I.

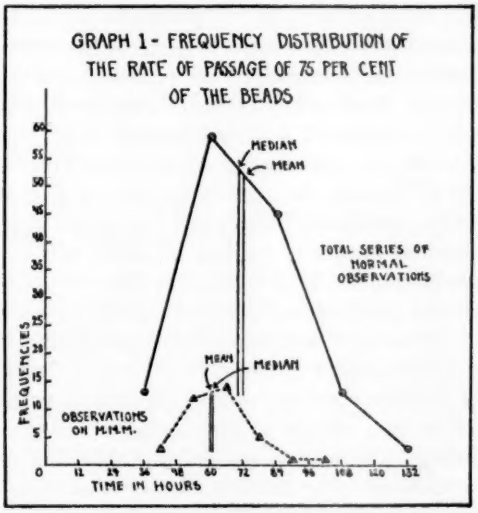
TABLE I

SUMMARY OF THE OBJECTIVE DATA MEASURING THE NORMAL FUNCTIONAL CHARACTERISTICS OF THE GASTRO-INTESTINAL TRACT OF THE THREE GROUPS OF SUBJECTS STUDIED

| Classification | No. of Subjects | Bead Days No. of | Rate of Laxation | Wt. of Feces | Time Between Defecations | Appearance of Beads | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Initial | 25% | 50% | 75% | Final |
| | | | No/24 hrs. | Oz. | Hours | Hrs. | Hrs. | Hrs. | Hrs. | Hrs. |
| Rapid ..... | 1 | 36 | 1.38 | 4.04 | 18 | 26 | 40 | 47 | 61 | 100 |
| Intermediate . | 4 | 48 | .98 | 3.56 | 24 | 27 | 42 | 52 | 70 | 113 |
| Slow ..... | 4 | 48 | 1.08 | 2.54 | 22 | 30 | 54 | 66 | 84 | 117 |
| Total Group . | 9 | 132 | 1.13 | 3.2 | 22 | 28 | 46 | 56 | 72 | 111 |

There is little published evidence for the evaluation of the normality of the individuals acting as subjects for this study. There are no available data on women. Alvarez and Freedlander, studying the rate of passage of beads in normal young men, found that most subjects took 4 days to eliminate 75 per cent of them. This is 33 per cent longer than our average time of 72 hours. The slowest group in our series took 84 hours,

in comparison with the 96 which Alvarez and Freedlander found normal. In only 12 per cent of the 132 normal observations was the passage of 75 per cent of the beads delayed to 96 or more hours, and in 15 per cent it was one half what these investigators considered normal. Graph 1 shows a positive skewness of .29 in our frequency distribution of the rate of passage of 75 per cent of the beads, thus magnifying the differences cited. The cause for the massing of the scores at the lower end of the scale probably resides in the fact that 27 per cent of the total number of observations were made on subject M.M.M. with a mean rate of passage of only 60 hours. Graph 1 includes the frequency polygon derived from the data




obtained upon her. The skewness in this distribution is negative, .23 being the measure of its displacement.

In 1924 Hoelzel repeated the experiments of Alvarez and Freedlander, studying other inert materials in addition to glass beads. His summary of this data records the "average rate of passage" of glass beads as 40.15 hours. If by this he means the average initial appearance of the beads, our findings are in as poor agreement with his as with those of Alvarez and Freedlander. We have no reason to suspect that the rates of passage observed in our experiments were abnormal. The time between defecations averaged 22 hours and the mean rate of laxation was 1.13.

Remembering that glass beads pass more slowly than indigestible food fragments, our normal findings are in accord with the recently published ones of Cowgill, Anderson, and Sullivan. They have evidence to believe that food residues require only 16 to 24 hours to traverse the alimentary canal. Burnett reports 62 and 134 hours as the initial and final time of appearance of millet seeds. If, as is more customary, we consider the dry

and scybalous stool which he takes as the desirable normal as one characteristic of constipation, and accept in its place his data for the soft, formed stool with few markings, our findings are also in excellent agreement with his. In such a stool the initial appearance of the millet seeds averaged 25 hours.

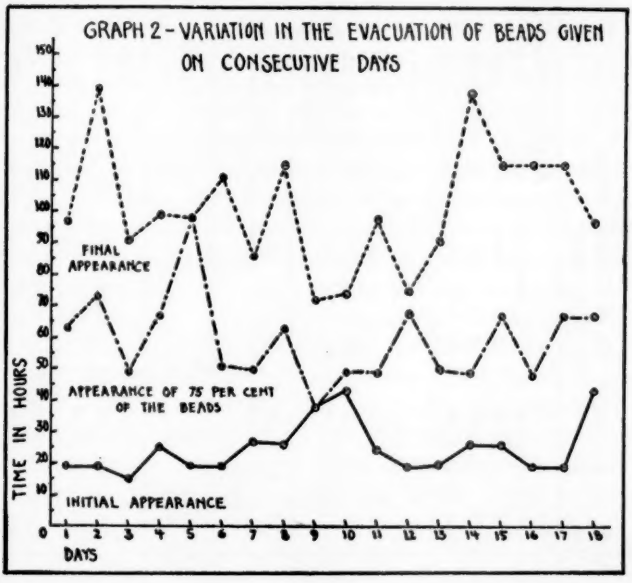
The "catching up phenomenon" first described by Alvarez and Freedlander when different colored beads were given on three successive days was by no means universally observed. Hoelzel confirmed its occurrence but failed to observe it after the first three days. In our study beads were given on successive days in series of six. Their average initial appearance measured in hours for eight different subjects was as follows: red, 28.75; gold, 27.50; blue, 25.25; black, 31.12; green, 29.50; and purple, 30.37. The slight differences are insignificant because of the extreme variability of the findings when the observations are repeated. Further, whereas in subject E.P. the first three colors of beads appeared in 48, 24, and 13 hours respectively, in subject H.T. they appeared in 24, 39, and 42 hours.

In agreement with the comment of Alvarez and Freedlander and the published graphs of Hoelzel, the rate of passage of glass beads through the gut is extremely capricious. This is well illustrated in Graph 2, which represents the normal results of subject M.M.M. under very constant experimental conditions. To facilitate in the interpretation of the data, the spread within the groups compared was therefore considered, and the reliability of the differences was measured, appreciating the limitations imposed by the small number of cases.

The effect of exercise upon the rate of passage of 75 per cent of the beads may be taken as a sample of the character and magnitude of the experimental findings. These are presented in Table II. Exercise failed to modify in any consistent way the irregularity observed in the normal series, as may be seen from an examination of the coefficients of variation. The obtained differences have little significance because of the wide scatter of the findings about their central tendency. In no single experiment did the critical ratio, $D/\sigma$diff., reach 3, the number customarily taken to indicate complete reliability of an obtained difference. A hastening of the rate of passage of the bulk of the beads by 8 hours has little meaning when the limits of variability for the majority of the cases before and during exercise are as great as 22 and 24 hours respectively below and above the mean. The incidental objective data substantiated the evidence obtained by the administration and recovery of glass beads. The influence of exercise upon the rate of laxation ranged from an averaged obtained difference of 00.04 to 00.11, weight of feces evacuated in 24 hours from 00.13 to 1.2 ounces, and interval between defecations from 0 to 4 hours.

An examination of the mean findings in Table II shows that abdominal exercise hastened the rate of passage of 75 per cent of the beads in the subjects classified as rapid and slow, but left uninfluenced those falling into the intermediate group. In no case is the reliability of the difference

high, but it is of interest to note that, in every member of the groups showing this hastening, the abdominal strength increased as a result of exercise, whereas in every member of the intermediate group the post-exercise abdominal strength was smaller than it had been at the beginning of the study. Pratt[18] had found that rigorous abdominal exercise accom-




panied by muscle soreness was frequently associated with a concomitant decrease in abdominal strength. The power of one of the subjects in the intermediate group fell off by twenty pounds and she complained bitterly of the severity of the exercise. In the other two the fall was slight. The average decrease in strength was 9.15 per cent in comparison with an increase of 8.8 per cent in the rapid subject and an average improvement of 11.42 per cent in the four individuals comprising the slow group.

The postexercise effect of the experimental procedure was followed in a number of cases. For example, after 24 continuous days of abdominal exercise the administration and recovery of beads was continued until 4 more series of 6 beads had been given. During the first 6 postexercise days the hastening which had been initiated continued in somewhat augmented form, but the difference again fell short of complete reliability, the critical ratio being 2.34. The succeeding 3 series of beads oscillated widely in their rate of passage, exceeding and again falling below the time interval necessary for the passage of 75 per cent of them in the pre-exercise observations. As a whole, the data failed to show any significant carry-over effect of the exercise.

*Comment.*—The normal gastro-intestinal motor power of the subjects

TABLE II

THE EFFECT OF EXERCISE UPON THE RATE OF PASSAGE OF 75 PER CENT OF THE BEADS THROUGH THE GASTRO-INTESTINAL TRACT

| Classification | No. of Subjects | No. of Bead Days | Mean | σ | Coef. of Variation | σAv. | No. of Subjects | No. of Bead Days | Mean | σ | Coef. of Variation | σAv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-exercise | | | | | | Abdominal Exercise | | | | | |
| Rapid | 1 | 18 | 59 | 13.49 | 22.85 | 3.18 | 1 | 24 | 52 | 9.53 | 18.32 | 1.95 |
| Intermediate | 3 | 36 | 69 | 18.27 | 26.47 | 3.04 | 3 | 36 | 69 | 16.00 | 23.18 | 2.66 |
| Slow | 4 | 48 | 84 | 22.84 | 27.19 | 3.30 | 4 | 48 | 76 | 24.12 | 31.73 | 3.48 |
| | Pre-exercise | | | | | | Tennis | | | | | |
| Rapid | 1 | 18 | 62 | 12.80 | 20.64 | 3.01 | 1 | 12 | 63 | 14.07 | 22.33 | 4.06 |
| Intermediate | 1 | 12 | 71 | 11.87 | 16.71 | 3.42 | 1 | 12 | 85 | 17.37 | 20.43 | 5.02 |
| | Pre-exercise | | | | | | Rowing | | | | | |
| Rapid | 1 | 8 | 53 | 10.05 | 18.96 | 3.56 | 1 | 8 | 47 | 7.87 | 16.74 | 2.79 |

*Difference*

| Classification | Exercise | Obtained Difference | σDiff. | D/σDiff. | Chances in 100 | Percentage Reliability |
|---|---|---|---|---|---|---|
| Rapid | Abdominal | 7 | 3.74 | 1.87 | 96.7 | 62.3 |
| Intermediate | Abdominal | 0 | 4.00 | 0.00 | 50 | 00.0 |
| Slow | Abdominal | 8 | 4.79 | 1.67 | 95.4 | 55.6 |
| Rapid | Tennis | 1 | 5.09 | 0.19 | 57.6 | 03.3 |
| Intermediate | Tennis | 14 | 6.08 | 2.30 | 98.9 | 76.6 |
| Rapid | Rowing | 6 | 4.47 | 1.34 | 90.8 | 44.6 |

used for this investigation may be responsible for the negativity of the results. Had the motility been depressed, exercise might have modified it. It was no more effective in the subject with a rate of 38 hours than in the subject who took 146 hours to evacuate the same number of beads. These, however, may merely represent the limits of normal variability, one being no more constipated than the other. An experimental slowing of the characteristic rate without accompanying disease might demonstrate an exercise effect too small to be significant when produced in the essentially normal. The tendency, though not uniform, was repeatedly toward hastening. *It was the degree of change which was of no moment.*

The extent of the variability of the functional power of the gastro-intestinal tract of any given subject as represented in Graph 2 is unexpected. Psychic and dietary irregularities, variations in physical activity, differences in water and roughage intake, medicaments, stimulating beverages, and tobacco smoking might all affect the motility of the bowel. These influences were well controlled in the régime under which those data were accumulated. We cannot account for the variance.

It should be pointed out that not only did exercise fail to significantly hasten the evacuation of inert material but it also failed to prevent its slowing to a level below normal. Playing tennis one hour daily was not an effective prophylactic. The greatest difference observed in any individual experiment was the fourteen-hour depression which tennis induced or permitted in subject R.E.B., who had at the outset a motor power classified as intermediate in rate. The percentage reliability of the difference is as high as any attained, but cannot be unqualifiedly accepted because of the small number of observations upon which it is based. In his general observations Hoelzel comments upon an inverse relation which he often observed between the general activity and the intestinal activity of his experimental animals. Exercise may be responsible for colonic delay. The unfavorable effect of excessive activity and fatigue has been clinically appreciated.[14]

## SUMMARY AND CONCLUSIONS

The influence of corrective and generalized exercise upon the motor power of the normal human gastro-intestinal tract was studied. The functional status of the alimentary canal was judged by objective criteria: rate of passage of glass beads, weight of the dejecta, number of hours between defecations, and rate of laxation. From evidence we conclude:

1. The normal functional activity of the gastro-intestinal tract is extremely variable.

2. Exercise does not influence the normal variability. It may lessen or increase, the differences being slight.

3. Exercise tends to hasten the rate of passage of glass beads, but the change is statistically insignificant because of the marked physiological variance.

4. Generalized exercise may cause, or does not prevent, a slowing of the rate of evacuation.

5. Specific abdominal exercise associated with an increase in abdominal strength tends to augment the rate of passage of glass beads while a reduction in abdominal strength tends to be associated with no such change, the differences in both cases being too small to be of consequence.

6. Exercise was associated with other variable changes the trend being to lengthen the time between defecations, decrease the rate of laxation, and increase the weight of the feces evacuated in twenty-four hours; but the differences were slight.

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# Grading Student Achievement in Golf Knowledge

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GRADING by "achievement" means "something accomplished." A commonly accepted idea of achievement may be interpreted to mean, a "difference" in performances of the same individual tested on two or more performances at different times. A score is used to express these performances. For example, Miss Kelley had a golf knowledge score of sixty-six when the first test was given and a score of eighty-nine at the close of the instruction period. The difference of twenty-three points between the two scores represents Miss Kelley's improvement or "achievement."

It is necessary to determine what the twenty-three points mean in relationship to revealing differences between students or groups of students' scores before "grading" can be accomplished. It is also necessary to be able to assign scores to individual achievements and to the initial test score of sixty-six and the final test score of eighty-nine.

Mr. Oktavec[1] says this can be done by showing: first, the relationship between the individual's scores at the end of the instruction period and the performances of his peers; second, the relationship between the student's first score and second score; third, a combination of the above two relationships.

Mr. Oktavec continues by saying that now the "task resolves itself into (1) examining the types of relationship that could be used in order to arrive at an achievement score; (2) interpreting the relationship scores for grading purposes; and (3) determining who the peers are to be, if the score is to be based on the relationship of a performance with those peers."

TABLES I, II, III, IV, V, VI, VII, and VIII at the end of the paper, give us our working data. In Table I may be seen the golf knowledge scores of 4 students in required physical education sections. In Tables II and III we have the golf knowledge scores of 89 women students in 4 sections taken after 2 weeks' instruction and their final golf knowledge scores at the close of the period of instruction and of the golf knowledge scores of 408 young women at the end of the instruction periods. In Table

[1] Frank L. Oktavec. "Grading Student Achievement in Physical Education Activities." Research Quarterly of the American Physical Education Association, I:93 (March, 1931).

IV is a method of assigning grades to 408 young women by the T-scale method of grading in accordance with the normal probability curve. Table V shows the achievement scores between the initial and final scores, frequency and T-scale scores of 89 young women students. In Table VI we have the grade and T-scale or achievement in golf knowledge scores of 89 young women in 4 sections of physical education. In Table VII may be seen the grades, score, and number of young women making the grades according to probability curve when the initial test is scaled, the final test scaled, and the achievement test scaled, and an average made of these three grades.

Table VIII gives the four students' increase in golf knowledge between the initial and final test in points, grades based on T-scale score achievement, and grades based on scaled initial test, scaled final test, and scaled achievement.

The peers for comparing the scores of four students, Jones, Smith, Kelley, and Johnson, were those students enrolled in physical education sections one, four, six, and eleven. This was done because grading, diagnosing, and instructing were the prompting influences rather than comparing the achievements of students of one college with another.

In Table III, columns 7 and 8, are included the frequency and past T-scale scores of 16 sections of physical education in which were enrolled 408 students. These scores could be used when comparing present class scores with past class scores under same instructors or different instructors.

In the Texas State College for Women the marking system is the Modal system of marks having five letters *A*, *B*, *C*, *D*, and *F*. The general tendency seems to distribute the letters according to the normal curve 7 per cent, 24 per cent, 38 per cent, 24 per cent, and 7 per cent.

THIS paper will not go into the discussion of ranking or percentile ranking, as it is commonly understood that it is not fair to assume that the difficulty of low scores on the scale have the same difficulty as scores higher up on the scale. Nor is it the purpose of this paper to discuss accomplishment quotients as difficulties arise when attempting to measure intelligence above the fourteenth year.

The T-scale technique of McCall[2] gives an opportunity, besides obtaining a score for actual performance, for obtaining an improvement score or a score of the relative difficulty of achievement regardless of where it is found on the scale, and for obtaining a distribution of the variability of achievement which approximates the normal. In Tables IV and VI a comparison of percentages and number of students' grades may be made with that of the normal probability curve. The writer followed McCall's technique of constructing a T-scale.

[2] William A. McCall. *How to Measure in Education*, pp. 272-305. New York: The Macmillan Company, 1923.

A method of grading difference between two performances follows:

As may be seen in Table I, the students, Jones, Smith, Kelley, and Johnson, increased their golf knowledge scores 9, 17, 23, and 39 points respectively. In Table V an improvement of 9 points shows a T-scale score of 46.5, 17 a T-scale score of 57, 23 a T-scale score of 61.5, and 39 shows a T-scale score of 75.5. Turning to Table VI, the letter grade for T-scale 46.5 is *C*, for 57 is *B*, for 61.5 *B*, and for 75.5 *A*. Marking students on basis of raw score improvement alone makes it possible for a student to do poor work on the first test in order to increase his score on the second test. It also assumes that equal increments of score are of the same difficulty regardless of position on the scale.

Another method is to scale the scores on the first test, using this first scale, and then assign the student a scaled score equal to his final test score. Subtracting the scaled initial test score from the scaled final test score, gives the difference in T-scale units. These may be placed in a frequency table and graded according to their position on the scale.

Referring to Table III, column three, we find Miss Jones 60 minus 55, or 5; Miss Smith, 68.5 minus 58, or 10.5; Miss Kelley 85 minus 60 or 25; and Miss Johnson 67 minus 34.5,or 32.5. This brings out the fact that Miss Johnson's raw score increased 39 points while her improvement was 32.5 T-scale units; while Miss Kelley's raw score was 23 points and her improvement was 25 T-scale units, or the difficulty of the upper part of the scale is greater from 66 to 89 than the part from 38 to 77.

A method that Brace[8] used in grading takes into consideration the initial test, the final test, and the improvement. The initial and final tests are scaled and scores obtained for each. The differences in scores are calculated and scaled. All three scaled scores are added and divided by three. Miss Jones's scaled scores (as taken from Table III, column 3) are 55 plus 60 added to the improvement score 46.5 (read improvement from raw scores, Table III, column 1, then read T-scale score for improvement from Table V). This total divided by three gives a score of 53.8. Miss Smith's would be 58 plus 68.5 plus 57 divided by 3, which gives a score of 61.16; Miss Kelley's 60 plus 85 plus 61.5 which gives a score of 68.83; and Miss Johnson's 34.5 plus 67 plus 75.5 which gives a score of 59. The letter grades of these 4 scores may be obtained from Table VII. Miss Jones's letter grade will be *C*, Miss Smith's *B*, Miss Kelley's *A*, and Miss Johnson's *B*. Table VIII shows the increase in raw scores, grades based on achievement, and grades based on the initial, the final, and the achievement scores of the 4 students.

The improvement, it seems to me, should be obtained the same as the T-scale scores. Take the raw score improvement and read from the T-scale improvement Table V. This table was based on the raw score improvement, not the improvement from T-scale scores.

[8]D. K. Brace. "Possibilities of Tests in Physical Education." *American Physical Education Review*, 32:229:506-513.

IN THIS paper has been discussed the relationship of crude scores and T-scale scores in revealing correct differences between students' scores; the relative difficulty of achievement regardless where found on the scale; and the change in grades when using achievement for basis of grading or taking into consideration the initial test, the final tests, and achievement. The T-scale, according to the normal probability curve, of the initial and final scores of 89 students, the final test of a group of 408 students, and achievement T-scale score frequency of 89 students are included in the tables.

TABLE I

GOLF KNOWLEDGE SCORE OF FOUR STUDENTS IN PHYSICAL EDUCATION SECTIONS IIIA-1, IIIA-4, IIIA-6 AND 211-11

| Name | After first two weeks' instruction | End of period of instruction | Increase in golf knowledge scores |
|---|---|---|---|
| Jones | 58 | 67 | 9 |
| Smith | 62 | 79 | 17 |
| Kelley | 66 | 89 | 23 |
| Johnson | 38 | 77 | 39 |

TABLE II

GOLF KNOWLEDGE SCORE OF FOUR STUDENTS

| First | Second |
|---|---|
| Johnson | |
| Jones | |

TABLE III

GOLF KNOWLEDGE SCORE AND T-SCALE SCORES

| | | 4 sections 89 scores | | | 4 sections 89 scores | | 16 sections 408 scores | |
|---|---|---|---|---|---|---|---|---|
| | | After first two weeks' instruction | | | End of period of instruction | | End of period of instruction | |
| | | 1 | 2 | 3 | 4 | 5 | 7 | 8 |
| | | Golf Knowledge Scores | Frequencies | T-scale Score Normal Curve | Frequencies | T-scale Score | Frequencies | T-scale Score |
| | | 27 | 2 | 27 | | | 1 | 19.5 |
| | | 28 | 0 | 30 | | | 0 | 22 |
| | | 29 | 0 | 30 | | | 0 | 22 |
| | | 30 | 2 | 31.5 | | | 0 | 22 |
| | | 31 | 0 | 33 | | | 0 | 22 |
| | | 32 | 0 | 33 | | | 0 | 22 |
| | | 33 | 0 | 33 | 1 | 24.5 | 1 | 23.5 |
| | | 34 | 1 | 34 | 0 | 27 | 0 | 24 |
| | | 35 | 0 | 34 | 0 | 27 | 1 | 25 |
| | | 36 | 0 | 34 | 1 | 28.5 | 3 | 27 |
| | | 37 | 0 | 34 | 0 | 30 | 1 | 28.5 |
| | | 38 | 1 | 34.5 | 0 | 30 | 2 | 29.5 |
| | | 39 | 3 | 36.5 | 0 | 30 | 2 | 30.5 |
| | | 40 | 0 | 37.5 | 0 | 30 | 3 | 31.5 |
| | | 41 | 0 | 37.5 | 0 | 30 | 1 | 32 |
| | | 42 | 2 | 38 | 0 | 30 | 3 | 32.5 |
| | | 43 | 4 | 38 | 0 | 30 | 1 | 33 |
| | | 44 | 3 | 41 | 0 | 30 | 1 | 34 |
| | | 45 | 1 | 42 | 0 | 30 | 5 | 34 |
| | | 46 | 1 | 42 | 0 | 30 | 5 | 35 |
| | | 47 | 1 | 43 | 1 | 31 | 6 | 36 |
| | | 48 | 1 | 43 | 0 | 31.5 | 6 | 37 |
| | | 49 | 3 | 43.5 | 1 | 32.5 | 13 | 38 |
| | | 50 | 3 | 44.5 | 0 | 33 | 5 | 39 |
| | | 51 | 7 | 46.5 | 0 | 33 | 9 | 40 |
| | | 52 | 4 | 48 | 2 | 34 | 5 | 40.5 |
| | | 53 | 5 | 49 | 0 | 35 | 7 | 41 |
| | | 54 | 4 | 50.5 | 5 | 37 | 12 | 42 |
| | | 55 | 4 | 51.5 | 1 | 38.5 | 16 | 43 |
| | | 56 | 2 | 52.5 | 4 | 40 | 15 | 44.5 |
| | | 57 | 6 | 54 | 0 | 40.5 | 9 | 45 |
| | | 58 | 3 | 55 | 4 | 41.5 | 11 | 46 |

TABLE II
(*Continued*)

| Golf Knowledge Score of Four Students | | |
|---|---|---|
| First | Second | |
| | | |
| Smith | | |
| | | |
| | | |
| | | |
| Kelley | | |
| | Jones | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | Johnson | |
| | | |
| | Smith | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | Kelley | |

TABLE III
(*Continued*)

| Golf Knowledge Score and T-Scale Scores | | | | | | |
|---|---|---|---|---|---|---|
| 4 sections 89 scores | | | 4 sections 89 scores | | 16 sections 408 scores | |
| After first two weeks' instruction | | | End of period of instruction | | End of period of instruction | |
| 1 | 2 | 3 | 4 | 5 | 7 | 8 |
| Golf Knowledge Scores | Frequencies | T-scale Score Normal Curve | Frequencies | T-scale Score | Frequencies | T-scale Score |
| 59 | 1 | 55.5 | 4 | 43 | 10 | 46.5 |
| 60 | 1 | 56 | 3 | 44.5 | 8 | 47 |
| 61 | 4 | 57 | 0 | 45 | 10 | 48 |
| 62 | 2 | 58 | 2 | 45.5 | 10 | 49 |
| 63 | 1 | 58.5 | 3 | 46 | 15 | 49 |
| 64 | 1 | 59 | 5 | 47 | 7 | 50 |
| 65 | 1 | 59.5 | 3 | 48.5 | 14 | 50.5 |
| 66 | 1 | 60 | 1 | 49 | 14 | 51.5 |
| 67 | 0 | 60 | 9 | 50.5 | 21 | 53 |
| 68 | 0 | 60 | 2 | 52 | 14 | 53.5 |
| 69 | 3 | 60.5 | 2 | 52.5 | 12 | 54.5 |
| 70 | 3 | 62.5 | 4 | 53.5 | 12 | 55 |
| 71 | 3 | 64.5 | 2 | 54.5 | 9 | 56 |
| 72 | 0 | 66 | 2 | 55 | 14 | 57 |
| 73 | 0 | 66 | 1 | 55.5 | 8 | 58 |
| 74 | 0 | 66 | 0 | 55.5 | 7 | 58.5 |
| 75 | 0 | 66 | 2 | 56 | 11 | 59 |
| 76 | 1 | 66 | 4 | 57 | 12 | 60 |
| 77 | 0 | 67 | 4 | 58.5 | 7 | 61.5 |
| 78 | 0 | 67 | 1 | 59.5 | 8 | 62 |
| 79 | 2 | 68.5 | 3 | 60 | 9 | 63.5 |
| 80 | 1 | 71 | 2 | 61.5 | 7 | 65 |
| 81 | 1 | 75.5 | 4 | 63.5 | 5 | 66 |
| 82 | 0 | 77 | 1 | 65.5 | 2 | 67 |
| 83 | 0 | 78 | 2 | 67 | 5 | 68 |
| 84 | 0 | 79 | 0 | 68.5 | 2 | 69 |
| 85 | 0 | 80 | 2 | 70 | 3 | 70 |
| 86 | 0 | 81 | 0 | 71.5 | 1 | 71 |
| 87 | 0 | 83 | 0 | 71.5 | 1 | 71.5 |
| 88 | 0 | 84 | 0 | 71.5 | 3 | 73 |
| 89 | 0 | 85 | 1 | 75.5 | 3 | 77 |

## TABLE IV

GRADES, T-SCALE SCORES, NUMBER, PER CENT OF 408 GOLF KNOWLEDGE SCORES. GOLF KNOWLEDGE SCORES COMPARED TO PER CENT AND NUMBER INVOLVED IN NORMAL CURVE.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Grades | T-scale scores | Number | Per cent of 408 scores | Number according to normal curve | Per cent of normal curve |
| *A* ..... | 66–77 | 32 | 7.9 | 29 | 7 |
| *B* ..... | 56–65 | 97 | 23.78 | 98 | 24 |
| *C* ..... | 45–55 | 155 | 38 | 155 | 38 |
| *D* ..... | 35–44.5 | 96 | 23.58 | 98 | 24 |
| *F* ..... | 20–34.5 | 28 | 6.86 | 28 | 7 |
| | | 408 | 100.12 | | |

## TABLE V

GOLF KNOWLEDGE ACHIEVEMENT SCORES
FREQUENCY, AND T-SCALE SCORES OF ACHIEVEMENT OF 89 STUDENTS

| Score | X | T-scale score | Score | X | T-scale score | Score | X | T-scale score | Score | X | T-scale score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | 2 | | | 3 | | | 4 | |
| —10 | 1 | 24.5 | 3 | 4 | 38 | 16 | 4 | 56 | 29 | 1 | 64.5 |
| — 9 | 0 | 27 | 4 | 4 | 40 | 17 | 1 | 57 | 30 | 1 | 65.5 |
| — 8 | 0 | 27 | 5 | 3 | 41.5 | 18 | 1 | 57.5 | 31 | 1 | 66.5 |
| — 7 | 0 | 27 | 6 | 5 | 43 | 19 | 1 | 58 | 32 | 3 | 69 |
| — 6 | 0 | 27 | 7 | 3 | 44.5 | 20 | 5 | 59 | 33 | 0 | 72.5 |
| — 5 | 0 | 27 | 8 | 1 | 45 | 21 | 0 | 60 | 34 | 0 | 72.5 |
| — 4 | 0 | 27 | 9 | 9 | 46.5 | 22 | 1 | 60.5 | 35 | 0 | 72.5 |
| — 3 | 2 | 30 | 10 | 3 | 48.5 | 23 | 3 | 61.5 | 36 | 0 | 72.5 |
| — 2 | 1 | 32.5 | 11 | 6 | 49.9 | 24 | 1 | 62.5 | 37 | 0 | 72.5 |
| — 1 | 0 | 33 | 12 | 3 | 51 | 25 | 1 | 63 | 38 | 0 | 72.5 |
| 0 | 0 | 33 | 13 | 4 | 52 | 26 | 0 | 63.5 | 39 | 1 | 75.5 |
| 1 | 3 | 34.5 | 14 | 6 | 53.5 | 27 | 0 | 63.5 | | | |
| 2 | 1 | 36 | 15 | 4 | 55 | 28 | 1 | 64 | | | |

TABLE VI

THE ACHIEVEMENT GRADE AND T-SCALE SCORE EIGHTY-NINE GOLF KNOWLEDGE SCORES OF STUDENTS PHYSICAL EDUCATION SECTIONS ONE, FOUR, SIX, AND ELEVEN

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Grade | T-scale score | Number | Approximate per cent according to T-scale score | Number according to normal curve | Per cent according to normal curve |
| *A* ..... | 66.5–75.5 | 5 | 5.61 | 6.23 | 7 |
| *B* ..... | 56 –65.5 | 21 | 23.6 | 21.36 | 24 |
| *C* ..... | 46.5–55 | 35 | 39.3 | 33.82 | 38 |
| *D* ..... | 36 –45 | 21 | 23.6 | 21.36 | 24 |
| *F* ..... | 24.5–34.5 | 7 | 7.89 | 6.23 | 7 |
| | | | 100.00 | 89.00 | |

TABLE VII

GRADES, SCALE, NUMBER, NUMBER ACCORDING TO NORMAL CURVE, PER CENT ACCORDING TO NORMAL CURVE OF THE AVERAGE OF THE INITIAL TEST, FINAL TEST, AND ACHIEVEMENT OF EIGHTY-NINE GOLF KNOWLEDGE SCORES

| Grade | Score | Number | Number according to normal curve | Per cent according to normal curve |
|---|---|---|---|---|
| *A* ..... | 65 –69 | 6 | 6.23 | 7 |
| *B* ..... | 57.5–63 | 20 | 21.36 | 24 |
| *C* ..... | 52 –57.49 | 35 | 33.82 | 38 |
| *D* ..... | 45.5–51 | 22 | 21.36 | 24 |
| *F* ..... | 34 –45.49 | 6 | 6.23 | 7 |
| | | 89 | | |

TABLE VIII

FOUR STUDENTS' INCREASE IN POINTS IN GOLF KNOWLEDGE SCORES; GRADES BASED ON ACHIEVEMENT FROM T-SCALE SCORE; GRADES BASED ON INITIAL, FINAL TESTS, AND ACHIEVEMENT FROM T-SCALE SCORE

| | Jones | Smith | Kelley | Johnson |
|---|---|---|---|---|
| Increase in golf knowledge scores..... | 9 | 17 | 23 | 39 |
| Grades based on achievement from T-scale scores..... | *C* | *B* | *B* | *A* |
| Grades based on initial, final, and achievement T-scale scores..... | *C* | *B* | *A* | *B* |

# What a Man Should Weigh

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## INTRODUCTION

THE INVESTIGATOR has attempted to present, in an abbreviated form, the findings from a thesis on "Body Weight in Relation to Certain Skeletal Measurements," which was accepted at New York University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

This abbreviated thesis must necessarily leave out a large part of the original data, such as statistical data, methods of study, tables, charts, and detailed explanations. From the standpoint of proof these facts are essential, but for practicability and ease of understanding the present form would seem to be sufficient. The conclusions and findings of the study are given. These findings include formulas for estimating what a man should weigh according to his skeletal build. The use of these should soon convince an individual of their extreme value as an index of body weight for men.

The formulas given in this study are for men from ages sixteen through twenty-two. Although the tables of this study do not go beyond twenty-two years of age, the investigator has used the formula for estimating the weight of men of twenty-two years of age, for men of all ages beyond twenty-two. The results have been very gratifying and seem to indicate that skeletal builds probably do not change very much after the age of twenty-two. The use of the formula of this twenty-two-year-old group is, therefore, recommended for adults twenty-two years of age and beyond. Further study may bring out formulas for the ages beyond twenty-two which will be slightly better than the above.

## THE PURPOSE OF THE STUDY

For a long time the individual's weight, taken in conjunction with his height, has been considered an index of the state of health and of nutrition. Much confidence has been placed in tables showing exactly what the individual should weigh, and many persons have sought to make themselves over so that they would approximate the so-called *normal* weight.

In various places where the height-weight tables have been used—as in the public schools of Springfield, Massachusetts—wide variations from the predictions have been noted. Not infrequently it occurred

that a subject weighing far too little according to the table, was found to be in perfect health as far as could be ascertained.

The use of the height-weight tables has led to a questioning of their values as an index of normal weight. This questioning has led to various studies such as those of Highsmith and Sorenson,[1] Wayman,[2] Boillin,[3] and Franzen.[4] Each of these studies indicates that the use of height alone as an index of body weight will result in many variations from the predictions.

The present study was undertaken to investigate the relation between weight and the skeletal build of men. As body weight is considered to be an important index of nutrition and of health, it is important that we should know how much of the body weight differences are due to differences in the skeletal build.

If a hundred men of the same age, selected at random, were lined up according to height, there would be a range of men from very tall down to very short. If these men were studied, it would be found that they vary just as much in other skeletal measurements as they do in height. These men might be lined up according to weight, to shoulder width, to hip width, and so on. Each time the men were lined up the men would be found to be in a different place in the line. In other words individuals do not conform to a mold but are of various weights and builds even though they are of the same age. They may be tall but very slender; they may be tall but very broad; they may be tall and of medium build; they may be short and slender, short and broad, or any variation in build. If the man happens to be the medium build his weight will approximate the weight prediction of the height-weight tables but otherwise it will not be very close.

Because men do vary so much in build, it has seemed to the investigator, that a table that would give a reliable index of weight should be made up from the measurements of the frame of the body, the skeleton. The logical measurements to take upon the skeleton would be those which would measure a length, depth, and width of the skeleton. The measuring of the skeleton in this three-dimensional manner would lead to the taking of the height, the shoulder width, the chest width, the hip width, and the chest depth. These five measurements give a very accurate index of the size of the skeleton.

The purpose of this study has been, then, to investigate the relation-

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[1] J. A. Highsmith and Dorothea Sorenson, "A Tentative Weight Prediction Formula," *American Physical Education Review* (September, 1928), 448.

[2] Agnes R. Wayman, *Education Through Physical Education*, Second Edition, pp. 94, 95, 98. Philadelphia: Lea and Febiger, 1928.

[3] Mary Louise Boillin, *Determination of the Interrelations, Partial and Multiple, Between Various Anthropometric Measurements of College Women*, pp. 30-39. New York: Bureau of Publications, Teachers College, Columbia University, 1930.

[4] Raymond Franzen, *Physical Measures of Growth and Nutrition*. New York: American Child Health Association, 1929.

ships that exist between body weight and the skeletal build, as judged by the individual's height, shoulder width, chest width, chest depth, and hip width.

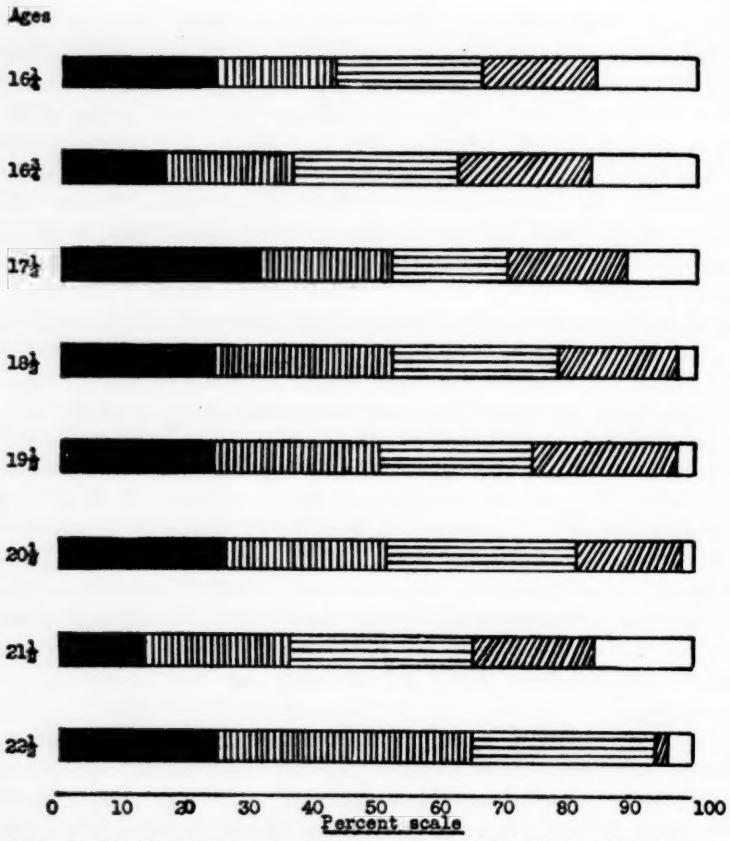
## THE STUDY AND SOME OF THE FINDINGS

The 5 measurements, of height, shoulder width, chest width, chest depth, and hip width, were taken upon 2,500 men, between the ages of 16 and 22. It was felt that age was an important factor in the differences in the weight and, therefore, the data was grouped by ages. For each age group from 16 through 22 the investigator found the relationships between the weight and the skeletal measurements. These relationships were found by the computation of correlations, multiple correlations, and the coefficient of standard scores in the multiple regression equation.

A simple question needs to be asked and answered, which is: "How much of an individual's weight is due to his height, to his shoulder width, to his chest depth, to his chest width, to his hip width?" In other words, how much influence will height have on the weight of an eighteen-year-old boy; how much influence will the width of the shoulders have, the width of the chest, the depth of the chest, the width of the hips? In answering this question information will be obtained that will tell immediately whether any single skeletal measurement is a sufficient guide for estimating what an individual should weigh. Chart I gives very clearly these influences upon the body weight. Certainly no one of the five measurements is so superior that it alone should be used for estimating the weight. In fact, it would be difficult to select any one of the five measurements that is not relatively important in its influence upon weight.

A second question needs to be asked and answered: How will various combinations of these measurements influence the weight? The answer (Table I) is that no definite combination for all the age groups stands as a superior influence upon weight, except the combination of all five. (Due to the lack of space it has been impossible to include all of the tables which show the relative value of weight predictions using various combinations of skeletal dimensions.) This leads to the conclusion that the skeletal growth is different at different ages, and therefore, a formula that would be best for predicting the weight of a sixteen-year-old boy would not be satisfactory for estimating the weight of a twenty-year-old boy.

A third question might be: "What will we use for estimating what an individual should weigh?" A formula that will fit each age needs to be made. These formulas must give each skeletal factor its proper influence, e.g., for 16 years of age chest width does not have nearly the influence upon weight that it has at 22 years of age (Chart I), while hip width at 20 years of age is relatively unimportant as compared to its




Diag. 9. The Proportionate Influence upon Weight of Five Skeletal Measurements for 16½ to 22½ Years, inclusive.

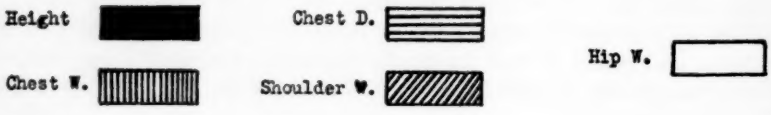



CHART I

TABLE I.

RELATIVE VALUE OF WEIGHT PREDICTIONS USING VARIOUS COMBINATIONS OF SKELETAL DIMENSIONS (VALUES IN TERMS OF $R^2$)
18½ YEARS OF AGE GROUP

| | $R^2$ |
|---|---|
| Hip Width | .1764 |
| Chest Depth | .2143 |
| Height | .2227 |
| Shoulder Width | .2819 |
| Height & Hip W. | .2894 |
| Chest D. & Hip. W. | .3192 |
| Chest W. | .3214 |
| Shoulder W. & Hip W. | .3516 |
| Chest W. & Hip W. | .3600 |
| Height & Shoulder W. | .3733 |
| Height & Chest D. | .3943 |
| Height, Shoulder W. & Hip. W. | .4057 |
| Shoulder W. & Chest W. | .4186 |
| Shoulder W. & Chest D. | .4186 |
| Height, Chest D. & Hip W. | .4264 |
| Chest W. & Chest D. | .4329 |
| Shoulder W., Chest W. & Hip W. | .4408 |
| Height & Chest W. | .4469 |
| Height, Chest W. & Hip W. | .4556 |
| Chest W., Chest D. & Hip W. | .4556 |
| Shoulder W., Chest D. & Hip W. | .4596 |
| Height, Shoulder W., & Chest W. | .4942 |
| Height, Shoulder W., Chest W. & Hip W. | .4998 |
| Height, Shoulder W. & Chest D. | .4998 |
| Shoulder, Chest W. & Chest D. | .5126 |
| Height, Shoulder W., Chest D. & Hip W. | .5155 |
| Shoulder W., Chest W., Chest D. & Hip W. | .5241 |
| Height, Chest W. & Chest D. | .5476 |
| Height, Chest W., Chest D. & Hip W. | .5490 |
| Height, Shoulder W., Chest W. & Chest D. | .5836 |
| Height, Shoulder W., Chest W., Chest D. & Hip W. | .5852 |

0 10 20 30 40 50 60 70 80

*Square of Correlation with Weight*

effect at 16 years of age. These factors have to be considered. By finding the multiple regression equations for each age group, every skeletal factor is given its proper weighting (Tables II through IX). For example, these equations give to the 16-years-of-age formula much less influence for chest width than is given to the chest width in the formula for 22 years of age. In the former the chest width is multiplied by 5.38 while in the latter the chest width is multiplied by 13.4. Thus, each age formula is so made that each of the 5 skeletal measurements will be given the exact value that it has in influencing weight. In other words, if the height accounts for 50 per cent of the weight, it will be so rated, but if it accounts for only 10 per cent of the weight it will also be so rated, and so on for each of the five measurements.

## THE FORMULAS FOR A WEIGHT INDEX AND THEIR USE

The use of these formulas will change the conception now held of what constitutes underweight and overweight. Many men who have been many pounds underweight or overweight by the height-weight tables, will be found to weigh within a few pounds of what the formulas predict for them. A few examples may help to indicate what results may be expected from the use of these formulas for a weight index.

In the fall of 1932 the investigator weighed and measured 446 men. Of these men 174 were at least 10 per cent over- or underweight by the height-weight tables. On these same men the formulas of this study were used. The predictions gave *only 50 men* who were at least 10 per cent over- or underweight. In other words, 124 of the men who would ordinarily be called over- or underweight were normal when consideration was given to their skeletal builds and each factor weighted accordingly.

The following procedure should be used in taking the measurements and in using the formula:

1. Take the age, height, weight, shoulder width, chest width, chest depth, and hip width. The height (without shoes) should be recorded to five-tenths of an inch. The weight (without clothes) should be recorded in pounds. The other four measurements should be taken with a curved chest caliper and recorded to tenths of an inch. (A sliding wooden caliper will do, but is less accurate for the chest depth measurement.) The shoulder width is measured from the back and is the distance between the acromian processes when the shoulders are held in a neutral position, e.g., neither forward nor back. The chest width is taken from the point on the ribs at the nipple level, while the individual is breathing normally. The chest depth is taken from the side at the nipple level, while the individual is breathing normally.* The hip width is

* In the original study the chest measurements were taken with the chest expanded and contracted and the midpoint used. In checking the difference between the measurement as taken above, and as formerly taken, this difference was so slight that the above method appears to be just as satisfactory and perhaps more so.

taken from the front and is the distance between the crests of the ilium (the top of the hip bones). All of these measurements should be taken on the skin.

2. Turn to the proper age table and follow out the formula given at the top of the page (Tables II through IX). To simplify the use of the formulas, multiplications of fractional parts of the skeletal measurements have been made into a table. For example, on the 16-years-of-age table (Table II) the formula says that the height is to be multiplied by 1.82. If a boy were 60 inches tall, this 60 would be multiplied by 1.82. To find the answer of 60 x 1.82 follow down the first column marked "Ht. in .5," to 60, and opposite this will be 109.02, the answer. The multiplication of the other measurements will be found by following down the proper columns of the table. The use of these tables will save all the multiplying of the formulas.

3. Add together the sums taken from the table (note, that in the twenty-two-years-of-age formula, the hip width sum is subtracted instead of added).

4. Subtract from the total obtained above the amount given to be subtracted by the formula for that particular age group.

Example of the use of the formula for a boy eighteen years of age: The measurements are:

| | | |
|---|---|---|
| Height | 71 | inches |
| Chest Depth | 7.27 | inches |
| Chest Width | 10.8 | inches |
| Shoulder Width | 10.6 | inches |
| Hip Width | 12.22 | inches |
| Weight | 132 | pounds |

On Table V we find the following formula: Weight = 1.91 Ht. + 4.89 Sh. W. + 8.86 Ch. W. + 7.80 Ch. D. + 1.22 Hip W. — 229.39. In using this formula the measurements would be multiplied as follows:

| | | | |
|---|---|---|---|
| Height ..... 71 | x 1.92 | (Answer—Follow down first column of table to opposite 71) | = 135.25 |
| Shoulder W. 12.6 | x 4.89 | (Answer—Follow down third column of table to opposite 12.6) | = 61.61 |
| Chest W. .. 10.8 | x 8.86 | (Answer—Follow down fifth column of table to opposite 10.8) | = 95.68 |
| Chest D. .. 7.27 | x 7.80 | (Answer—Follow down seventh column of table to opposite 7.2) | = 56.16 |
| Hip W. .... 12.2 | x 1.22 | (Answer—Follow down ninth column of table to opposite 12.2) | = 14.88 |
| | | Total | = 363.58 |

The next step in following out the formula is to subtract 229.39 (as per formula) from the total 363.58. This leaves 134.19 which is the estimated weight for this individual. His actual weight was 132 pounds.

## TABLE II

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 16¼-YEAR-OLD GROUP

*Formula:* Weight = 1.82 Ht. + 4.19 Sh. W. + 5.38 Ch. W. + 7.99 Ch. D. + 5.07 Hip. W. — 225.39

| Ht. in .5″ | Ht. x 1.82 | Sh. W. in .2″ | Sh. W. x 4.19 | Ch. W. in .2″ | Ch. W. x 5.38 | Ch. D. in .2″ | Ch. D. x 7.99 | Hip W. .2″ | Hip W. 5.07 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 101.92 | 10 | 41.90 | 8 | 43.04 | 5 | 39.95 | 8 | 40.56 |
| 56.5 | 102.83 | 10.2 | 42.73 | 8.2 | 44.11 | 5.2 | 41.54 | 8.2 | 41.57 |
| 57 | 103.74 | 10.4 | 43.57 | 8.4 | 45.19 | 5.4 | 43.14 | 8.4 | 42.59 |
| 57.5 | 104.65 | 10.6 | 44.41 | 8.6 | 46.26 | 5.6 | 44.74 | 8.6 | 43.60 |
| 58 | 105.56 | 10.8 | 45.26 | 8.8 | 47.34 | 5.8 | 46.34 | 8.8 | 44.61 |
| 58.5 | 106.47 | 11 | 46.09 | 9 | 48.42 | 6 | 47.94 | 9 | 45.63 |
| 59 | 107.38 | 11.2 | 46.92 | 9.2 | 49.49 | 6.2 | 49.53 | 9.2 | 46.64 |
| 59.5 | 108.29 | 11.4 | 47.76 | 9.4 | 50.57 | 6.4 | 51.13 | 9.4 | 47.65 |
| 60 | 109.02 | 11.6 | 48.60 | 9.6 | 51.65 | 6.6 | 52.73 | 9.6 | 48.67 |
| 60.5 | 110.11 | 11.8 | 49.44 | 9.8 | 52.72 | 6.8 | 54.33 | 9.8 | 49.68 |
| 61 | 111.02 | 12 | 50.28 | 10 | 53.80 | 7 | 55.93 | 10 | 50.70 |
| 61.5 | 111.93 | 12.2 | 51.11 | 10.2 | 54.87 | 7.2 | 57.52 | 10.2 | 51.71 |
| 62 | 112.84 | 12.4 | 51.95 | 10.4 | 55.95 | 7.4 | 59.12 | 10.4 | 52.72 |
| 62.5 | 113.75 | 12.6 | 52.79 | 10.6 | 57.02 | 7.6 | 60.72 | 10.6 | 53.74 |
| 63 | 114.66 | 12.8 | 53.63 | 10.8 | 58.10 | 7.8 | 62.32 | 10.8 | 54.75 |
| 63.5 | 115.57 | 13 | 54.47 | 11 | 59.18 | 8 | 63.92 | 11 | 55.77 |
| 64 | 116.48 | 13.2 | 55.30 | 11.2 | 60.25 | 8.2 | 65.51 | 11.2 | 56.78 |
| 64.5 | 117.39 | 13.4 | 56.14 | 11.4 | 61.33 | 8.4 | 67.11 | 11.4 | 57.79 |
| 65 | 118.30 | 13.0 | 56.98 | 11.6 | 62.40 | 8.6 | 68.71 | 11.6 | 58.81 |
| 65.5 | 119.21 | 13.8 | 57.82 | 11.8 | 63.48 | 8.8 | 70.31 | 11.8 | 59.82 |
| 66 | 120.12 | 14 | 58.66 | 12 | 64.56 | 9 | 71.91 | 12 | 60.84 |
| 66.5 | 121.03 | 14.2 | 59.49 | 12.2 | 65.63 | 9.2 | 73.50 | 12.2 | 61.85 |
| 67 | 121.94 | 14.4 | 60.33 | 12.4 | 66.71 | 9.4 | 75.10 | 12.4 | 62.86 |
| 67.5 | 122.85 | 14.6 | 61.17 | 12.6 | 67.78 | 9.6 | 76.70 | 12.6 | 63.88 |
| 68 | 123.76 | 14.8 | 62.01 | 12.8 | 68.86 | 9.8 | 78.30 | 12.8 | 64.89 |
| 68.5 | 124.67 | 15 | 62.85 | 13 | 69.94 | 10 | 79.90 | 13 | 65.91 |
| 69 | 125.68 | 15.2 | 63.68 | 13.2 | 71.01 | 10.2 | 81.49 | 13.2 | 66.92 |
| 69.5 | 126.49 | 15.4 | 64.52 | 13.4 | 72.09 | 10.4 | 83.09 | 13.4 | 67.93 |
| 70 | 127.40 | 15.6 | 65.36 | 13.6 | 73.16 | 10.6 | 84.69 | 13.6 | 68.95 |
| 70.5 | 128.31 | 15.8 | 66.20 | 13.8 | 74.24 | 10.8 | 86.29 | 13.8 | 69.96 |
| 71 | 129.22 | 16 | 67.04 | 14 | 75.32 | 11 | 87.89 | 14 | 70.98 |
| 71.5 | 130.13 | 16.2 | 67.87 | 14.2 | 76.39 | 11.2 | 89.48 | 14.2 | 71.99 |
| 72 | 131.04 | 16.4 | 68.71 | 14.4 | 77.47 | 11.4 | 91.08 | 14.4 | 73.00 |
| 72.5 | 131.95 | 16.6 | 69.55 | 14.6 | 78.54 | 11.6 | 92.68 | 14.6 | 74.05 |
| 73 | 132.86 | 16.8 | 70.39 | 14.8 | 79.62 | 11.8 | 94.28 | 14.8 | 75.03 |
| 73.5 | 133.77 | 17 | 71.23 | 15 | 80.70 | 12 | 95.88 | 15 | 67.05 |
| 74 | 134.68 | 17.2 | 72.06 | | | | | | |
| 74.5 | 135.59 | 17.4 | 72.90 | | | | | | |
| 75 | 136.50 | 17.6 | 73.74 | | | | | | |
| 75.5 | 137.41 | 17.8 | 74.58 | | | | | | |
| 76 | 138.32 | 18 | 75.42 | | | | | | |

## TABLE III

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 16¾-YEAR-OLD GROUP

*Formula:* Weight = 1.03 Ht. + 4.70 Sh. W. + 5.52 Ch. W. + 8.82 Ch. D. + 5.10 Hip W. — 189.61

| Ht. in .5″ | Ht. x 1.03 | Sh. W. in .2″ | Sh. W. x 4.70 | Ch. W. in .2″ | Ch. W. x 5.52 | Ch. D. in .2″ | Ch. D. x 8.82 | Hip W. in .2″ | Hip W. x 5.10 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 57.68 | 10 | 47 | 8 | 44.16 | 5 | 44.10 | 8 | 40.80 |
| 56.5 | 58.19 | 10.2 | 47.94 | 8.2 | 45.26 | 5.2 | 45.86 | 8.2 | 41.82 |
| 57 | 58.71 | 10.4 | 48.88 | 8.4 | 46.36 | 5.4 | 47.62 | 8.4 | 42.84 |
| 57.5 | 59.22 | 10.6 | 49.82 | 8.6 | 47.47 | 5.6 | 49.39 | 8.6 | 43.86 |
| 58 | 59.74 | 10.8 | 50.76 | 8.8 | 48.57 | 5.8 | 51.15 | 8.8 | 44.88 |
| 58.5 | 60.25 | 11 | 51.70 | 9 | 49.68 | 6 | 52.92 | 9 | 45.90 |
| 59 | 60.77 | 11.2 | 52.64 | 9.2 | 50.78 | 6.2 | 54.68 | 9.2 | 46.92 |
| 59.5 | 61.28 | 11.4 | 53.58 | 9.4 | 51.88 | 6.4 | 56.44 | 9.4 | 47.94 |
| 60 | 61.80 | 11.6 | 54.52 | 9.6 | 52.99 | 6.6 | 58.21 | 9.6 | 48.96 |
| 60.5 | 62.31 | 11.8 | 55.46 | 9.8 | 54.09 | 6.8 | 59.97 | 9.8 | 49.98 |
| 61 | 62.38 | 12 | 56.40 | 10 | 55.20 | 7 | 61.74 | 10 | 51 |
| 61.5 | 63.34 | 12.2 | 57.34 | 10.2 | 56.30 | 7.2 | 63.50 | 10.2 | 52.02 |
| 62 | 63.86 | 12.4 | 58.28 | 10.4 | 57.40 | 7.4 | 65.26 | 10.4 | 53.04 |
| 62.5 | 64.37 | 12.6 | 59.22 | 10.6 | 58.51 | 7.6 | 67.03 | 10.6 | 54.06 |
| 63 | 64.89 | 12.8 | 60.16 | 10.8 | 59.61 | 7.8 | 68.79 | 10.8 | 55.08 |
| 63.5 | 65.40 | 13 | 61.10 | 11 | 60.72 | 8 | 70.56 | 11 | 56.10 |
| 64 | 65.92 | 13.2 | 62.04 | 11.2 | 61.82 | 8.2 | 72.32 | 11.2 | 57.12 |
| 64.5 | 66.33 | 13.4 | 62.98 | 11.4 | 62.92 | 8.4 | 74.08 | 11.4 | 58.14 |
| 65 | 66.95 | 13.6 | 63.92 | 11.6 | 64.03 | 8.6 | 75.85 | 11.6 | 59.16 |
| 65.5 | 67.46 | 13.8 | 64.86 | 11.8 | 65.13 | 8.8 | 77.61 | 11.8 | 60.18 |
| 66 | 67.98 | 14 | 65.80 | 12 | 66.24 | 9 | 79.38 | 12 | 61.20 |
| 66.5 | 68.49 | 14.2 | 66.74 | 12.2 | 67.34 | 9.2 | 81.14 | 12.2 | 62.22 |
| 67 | 69.01 | 14.4 | 67.68 | 12.4 | 68.44 | 9.4 | 82.90 | 12.4 | 63.24 |
| 67.5 | 69.52 | 14.6 | 68.62 | 12.6 | 69.55 | 9.6 | 84.67 | 12.6 | 64.26 |
| 68 | 70.04 | 14.8 | 69.56 | 12.8 | 70.65 | 9.8 | 86.43 | 12.8 | 65.28 |
| 68.5 | 70.55 | 15 | 70.50 | 13 | 71.76 | 10 | 88.20 | 13 | 66.30 |
| 69 | 71.07 | 15.2 | 71.44 | 13.2 | 72.86 | 10.2 | 89.96 | 13.2 | 67.32 |
| 69.5 | 71.58 | 15.4 | 72.38 | 13.4 | 73.96 | 10.4 | 91.72 | 13.4 | 68.34 |
| 70 | 72.10 | 15.6 | 73.32 | 13.6 | 75.07 | 10.6 | 93.49 | 13.6 | 69.36 |
| 70.5 | 72.61 | 15.8 | 74.26 | 13.8 | 76.17 | 10.8 | 95.25 | 13.8 | 70.38 |
| 71 | 73.13 | 16 | 75.20 | 14 | 77.28 | 11 | 97.02 | 14 | 71.40 |
| 71.5 | 73.64 | 16.2 | 76.14 | 14.2 | 78.36 | 11.2 | 98.78 | 14.2 | 72.42 |
| 72 | 74.16 | 16.4 | 77.08 | 14.4 | 79.48 | 11.4 | 100.54 | 14.4 | 73.44 |
| 72.5 | 74.67 | 16.6 | 78.02 | 14.6 | 80.59 | 11.6 | 102.31 | 14.6 | 74.46 |
| 73 | 75.19 | 16.8 | 78.96 | 14.8 | 81.69 | 11.8 | 104.07 | 14.8 | 75.48 |
| 73.5 | 75.70 | 17 | 79.90 | 15 | 82.80 | 12 | 105.84 | 15 | 76.50 |
| 74 | 76.22 | 17.2 | 80.84 | | | | | | |
| 74.5 | 76.73 | 17.4 | 81.78 | | | | | | |
| 75 | 77.25 | 17.6 | 82.72 | | | | | | |
| 75.5 | 77.76 | 17.8 | 83.66 | | | | | | |
| 76 | 78.28 | 18 | 84.60 | | | | | | |

## TABLE IV

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR THE 17½-YEAR-OLD GROUP

*Formula:* Weight = 2.14 Ht. + 3.71 Sh. W. + 5.93 Ch. W. + 5.49 Ch. D. + 2.59 Hip W. — 199.45

| Ht. in .5″ | Ht. x 2.14 | Sh. W. in .2″ | Sh. W. x 3.71 | Ch. W. in .2″ | Ch. W. x 5.93 | Ch. D. in .2″ | Ch. D. x 5.49 | Hip W. in .2″ | Hip W. x 2.59 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 119.84 | 10 | 37.10 | 8 | 47.44 | 5 | 27.45 | 8 | 20.72 |
| 56.5 | 120.91 | 10.2 | 37.84 | 8.2 | 48.63 | 5.2 | 28.55 | 8.2 | 21.24 |
| 57 | 121.98 | 10.4 | 38.58 | 8.4 | 49.81 | 5.4 | 29.65 | 8.4 | 21.76 |
| 57.5 | 123.5 | 10.6 | 39.32 | 8.6 | 51 | 5.6 | 30.74 | 8.6 | 22.27 |
| 58 | 124.12 | 10.8 | 40.06 | 8.8 | 52.18 | 5.8 | 31.84 | 8.8 | 22.79 |
| 58.5 | 125.19 | 11 | 40.81 | 9 | 53.37 | 6 | 32.94 | 9 | 23.31 |
| 59 | 126.26 | 11.2 | 41.55 | 9.2 | 54.56 | 6.2 | 34.04 | 9.2 | 23.83 |
| 59.5 | 127.33 | 11.4 | 42.29 | 9.4 | 55.74 | 6.4 | 35.14 | 9.4 | 24.35 |
| 60 | 128.4 | 11.6 | 43.04 | 9.6 | 56.93 | 6.6 | 36.23 | 9.6 | 24.86 |
| 60.5 | 129.47 | 11.8 | 43.78 | 9.8 | 58.11 | 6.8 | 37.33 | 9.8 | 25.38 |
| 61 | 130.54 | 12 | 44.52 | 10 | 59.30 | 7 | 38.43 | 10 | 25.90 |
| 61.5 | 131.61 | 12.2 | 45.26 | 10.2 | 60.49 | 7.2 | 39.53 | 10.2 | 26.42 |
| 62 | 132.68 | 12.4 | 46 | 10.4 | 61.67 | 7.4 | 40.73 | 10.4 | 26.94 |
| 62.5 | 133.75 | 12.6 | 46.75 | 10.6 | 62.86 | 7.6 | 41.72 | 10.6 | 27.45 |
| 63 | 134.82 | 12.8 | 47.49 | 10.8 | 64.04 | 7.8 | 42.82 | 10.8 | 27.97 |
| 63.5 | 135.89 | 13 | 48.23 | 11 | 65.23 | 8 | 43.92 | 11 | 28.49 |
| 64 | 136.96 | 13.2 | 48.97 | 11.2 | 66.42 | 8.2 | 45.02 | 11.2 | 29.01 |
| 64.5 | 138.03 | 13.4 | 49.71 | 11.4 | 67.60 | 8.4 | 46.12 | 11.4 | 29.53 |
| 65 | 139.1 | 13.6 | 50.46 | 11.6 | 68.79 | 8.6 | 47.21 | 11.6 | 30.04 |
| 65.5 | 140.17 | 13.8 | 51.20 | 11.8 | 69.97 | 8.8 | 48.31 | 11.8 | 30.56 |
| 66 | 141.24 | 14 | 51.94 | 12 | 71.16 | 9 | 49.41 | 12 | 31.08 |
| 66.5 | 142.31 | 14.2 | 52.68 | 12.2 | 72.35 | 9.2 | 50.51 | 12.2 | 31.60 |
| 67 | 143.38 | 14.4 | 53.42 | 12.4 | 73.53 | 9.4 | 51.61 | 12.4 | 32.12 |
| 67.5 | 144.45 | 14.6 | 54.17 | 12.6 | 74.72 | 9.6 | 52.70 | 12.6 | 32.63 |
| 68 | 145.52 | 14.8 | 54.91 | 12.8 | 75.90 | 9.8 | 53.80 | 12.8 | 33.15 |
| 68.5 | 146.59 | 15 | 55.65 | 13 | 77.09 | 10 | 54.90 | 13 | 33.67 |
| 69 | 147.66 | 15.2 | 56.39 | 13.2 | 78.28 | 10.2 | 56. | 13.2 | 34.19 |
| 69.5 | 148.73 | 15.4 | 57.13 | 13.4 | 79.46 | 10.4 | 57.10 | 13.4 | 34.71 |
| 70 | 149.8 | 15.6 | 57.88 | 13.6 | 80.65 | 10.6 | 58.19 | 13.6 | 35.92 |
| 70.5 | 150.87 | 15.8 | 58.62 | 13.8 | 81.83 | 10.8 | 59.29 | 13.8 | 35.74 |
| 71 | 151.94 | 16 | 59.36 | 14 | 83.02 | 11 | 60.39 | 14 | 36.26 |
| 71.5 | 153.01 | 16.2 | 60.10 | 14.2 | 84.21 | 11.2 | 61.49 | 14.2 | 36.78 |
| 72 | 154.08 | 16.4 | 60.84 | 14.4 | 85.39 | 11.4 | 62.59 | 14.4 | 37.30 |
| 72.5 | 155.15 | 16.6 | 61.59 | 14.6 | 86.58 | 11.6 | 63.68 | 14.6 | 37.81 |
| 73 | 156.82 | 16.8 | 62.33 | 14.8 | 86.76 | 11.8 | 64.78 | 14.8 | 38.33 |
| 73.5 | 157.29 | 17 | 63.07 | 15 | 88.95 | 12 | 65.88 | 15 | 38.85 |
| 74 | 158.36 | 17.2 | 63.81 | | | | | | |
| 74.5 | 159.43 | 17.4 | 64.55 | | | | | | |
| 75 | 160.5 | 17.6 | 65.30 | | | | | | |
| 75.5 | 161.57 | 17.8 | 66.04 | | | | | | |
| 76 | 162.64 | 18 | 66.78 | | | | | | |

## TABLE V

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR THE 18½-YEAR-OLD GROUP

*Formula:* Weight = 1.91 Ht. + 4.89 Sh. W. + 8.86 Ch. W. + 7.80 Ch. D. + 1.22 Hip W. — 229.39

| Ht. in .5″ | Ht. x 1.91 | Sh. W. in .2″ | Sh. W. x 4.89 | Ch. W. in .2″ | Ch. W. x 8.86 | Ch. D. in .2″ | Ch. D. x 7.80 | Hip W. in .2″ | Hip W. x 1.22 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 106.68 | 10 | 48.90 | 8 | 70.88 | 5 | 39.00 | 8 | 9.76 |
| 56.5 | 107.63 | 10.2 | 49.87 | 8.2 | 72.65 | 5.2 | 40.56 | 8.2 | 10 |
| 57 | 108.58 | 10.4 | 50.85 | 8.4 | 74.42 | 5.4 | 42.12 | 8.4 | 10.24 |
| 57.5 | 109.58 | 10.6 | 51.83 | 8.6 | 76.19 | 5.6 | 43.68 | 8.6 | 10.49 |
| 58 | 110.49 | 10.8 | 52.81 | 8.8 | 77.96 | 5.8 | 45.24 | 8.8 | 10.73 |
| 58.5 | 111.44 | 11 | 53.79 | 9 | 79.74 | 6 | 46.80 | 9 | 10.98 |
| 59 | 112.39 | 11.2 | 54.76 | 9.2 | 81.51 | 6.2 | 48.36 | 9.2 | 11.22 |
| 59.5 | 113.34 | 11.4 | 55.74 | 9.4 | 83.28 | 6.4 | 49.92 | 9.4 | 11.46 |
| 60 | 114.30 | 11.6 | 56.72 | 9.6 | 85.05 | 6.6 | 51.48 | 9.6 | 11.71 |
| 60.5 | 115.25 | 11.8 | 57.70 | 9.8 | 86.82 | 6.8 | 53.04 | 9.8 | 11.95 |
| 61 | 116.20 | 12 | 58.68 | 10 | 88.60 | 7 | 54.60 | 10 | 12.20 |
| 61.5 | 117.15 | 12.2 | 59.65 | 10.2 | 90.37 | 7.2 | 54.16 | 10.2 | 12.44 |
| 62 | 118.11 | 12.4 | 60.63 | 10.4 | 92.14 | 7.4 | 57.72 | 10.4 | 12.68 |
| 62.5 | 119.06 | 12.6 | 61.61 | 10.6 | 93.91 | 7.6 | 59.28 | 10.6 | 12.93 |
| 63 | 120.01 | 12.8 | 62.59 | 10.8 | 95.68 | 7.8 | 60.84 | 10.8 | 13.17 |
| 63.5 | 120.96 | 13 | 63.57 | 11 | 97.46 | 8 | 62.40 | 11 | 13.42 |
| 64 | 121.92 | 13.2 | 64.54 | 11.2 | 99.23 | 8.2 | 63.96 | 11.2 | 13.66 |
| 64.5 | 122.87 | 13.4 | 65.52 | 11.4 | 101.00 | 8.4 | 65.52 | 11.4 | 13.90 |
| 65 | 123.02 | 13.6 | 66.50 | 11.6 | 102.77 | 8.6 | 67.08 | 11.6 | 14.15 |
| 65.5 | 124.77 | 13.8 | 67.48 | 11.8 | 104.54 | 8.8 | 68.64 | 11.8 | 14.39 |
| 66 | 125.73 | 14 | 68.46 | 12 | 106.32 | 9 | 70.20 | 12 | 14.64 |
| 66.5 | 126.68 | 14.2 | 69.43 | 12.2 | 108.09 | 9.2 | 71.76 | 12.2 | 14.88 |
| 67 | 127.63 | 14.4 | 70.41 | 12.4 | 109.86 | 9.4 | 73.32 | 12.4 | 15.12 |
| 67.5 | 128.58 | 14.6 | 71.39 | 12.6 | 111.63 | 9.6 | 74.88 | 12.6 | 15.37 |
| 68 | 129.54 | 14.8 | 72.37 | 12.8 | 113.40 | 9.8 | 76.44 | 12.8 | 15.61 |
| 68.5 | 130.49 | 15 | 73.75 | 13 | 115.18 | 10 | 78 | 13 | 15.86 |
| 69 | 131.44 | 15.2 | 74.32 | 13.2 | 116.95 | 10.2 | 79.56 | 13.2 | 16.10 |
| 69.5 | 132.39 | 15.4 | 75.30 | 13.4 | 118.72 | 10.4 | 81.12 | 13.4 | 16.34 |
| 70 | 133.35 | 15.6 | 76.28 | 13.6 | 120.49 | 10.6 | 82.68 | 13.6 | 16.59 |
| 70.5 | 134.30 | 15.8 | 77.26 | 13.8 | 122.26 | 10.8 | 84.24 | 13.8 | 16.83 |
| 71 | 135.25 | 16 | 78.24 | 14 | 124.04 | 11 | 85.80 | 14 | 17.08 |
| 71.5 | 136.20 | 16.2 | 79.21 | 14.2 | 125.81 | 11.2 | 87.36 | 14.2 | 17.32 |
| 72 | 137.16 | 16.4 | 80.19 | 14.4 | 127.58 | 11.4 | 88.92 | 14.4 | 17.56 |
| 72.5 | 138.11 | 16.6 | 81.16 | 14.6 | 129.35 | 11.6 | 90.48 | 14.6 | 17.81 |
| 73 | 139.06 | 16.8 | 82.15 | 14.8 | 131.12 | 11.8 | 92.04 | 14.8 | 18.05 |
| 73.5 | 140.01 | 17 | 83.13 | 15 | 132.90 | 12 | 93.60 | 15 | 18.30 |
| 74 | 140.97 | 17.2 | 84.10 | | | | | | |
| 74.5 | 141.92 | 17.4 | 85.08 | | | | | | |
| 75 | 142.87 | 17.6 | 86.06 | | | | | | |
| 75.5 | 143.82 | 17.8 | 87.04 | | | | | | |
| 76 | 144.76 | 18 | 88.02 | | | | | | |

## TABLE VI

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 19½-YEAR-OLD GROUP

*Formula:* Weight = 2.18 Ht. + 4.26 Sh. W. + 7.16 Ch. W. + 8.20 Ch. D. + .612 Hip W. — 217.37

| Ht. in .5″ | Ht. x 2.18 | Sh. W. in .2″ | Sh.W. x 4.26 | Ch. W. in .2″ | Ch. W. x 7.16 | Ch. D. in .2″ | Ch. D. x 8.20 | Hip W. in .2″ | Hip W. x .612 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 122.08 | 10 | 42.60 | 8 | 57.28 | 5 | 41 | 8 | 4.86 |
| 56.5 | 123.17 | 10.2 | 43.45 | 8.2 | 58.71 | 5.2 | 42.64 | 8.2 | 5.01 |
| 57 | 124.26 | 10.4 | 44.30 | 8.4 | 60.14 | 5.4 | 44.28 | 8.4 | 5.14 |
| 57.5 | 125.35 | 10.6 | 45.15 | 8.6 | 61.57 | 5.6 | 45.92 | 8.6 | 5.26 |
| 58 | 126.44 | 10.8 | 46.88 | 8.8 | 63 | 5.8 | 47.56 | 8.8 | 5.38 |
| 58.5 | 127.53 | 11 | 46.88 | 9 | 64.44 | 6 | 49.20 | 9 | 5.50 |
| 59 | 128.63 | 11.2 | 47.71 | 9.2 | 65.87 | 6.2 | 50.84 | 9.2 | 5.63 |
| 59.5 | 129.71 | 11.4 | 48.56 | 9.4 | 67.30 | 6.4 | 52.48 | 9.4 | 5.75 |
| 60 | 130.80 | 11.6 | 49.41 | 9.6 | 68.73 | 6.6 | 54.12 | 9.6 | 5.87 |
| 60.5 | 131.89 | 11.8 | 50.26 | 9.8 | 70.16 | 6.8 | 55.76 | 9.8 | 5.99 |
| 61 | 132.98 | 12 | 51.12 | 10 | 71.60 | 7 | 57.40 | 10 | 6.12 |
| 61.5 | 134.07 | 12.2 | 51.97 | 10.2 | 73.03 | 7.2 | 59.04 | 10.2 | 6.24 |
| 62 | 135.16 | 12.4 | 52.82 | 10.4 | 76.46 | 7.4 | 60.68 | 10.4 | 6.36 |
| 62.5 | 136.25 | 12.6 | 53.67 | 10.6 | 76.80 | 7.6 | 62.32 | 10.6 | 6.48 |
| 63 | 137.34 | 12.8 | 54.52 | 10.8 | 77.32 | 7.8 | 63.96 | 10.8 | 6.60 |
| 63.5 | 138.43 | 13 | 55.32 | 11 | 78.76 | 8 | 65.60 | 11 | 6.73 |
| 64 | 139.52 | 13.2 | 56.23 | 11.2 | 80.10 | 8.2 | 67.24 | 11.2 | 6.85 |
| 64.5 | 140.61 | 13.4 | 57.08 | 11.4 | 81.62 | 8.4 | 68.92 | 11.4 | 6.97 |
| 65 | 141.70 | 13.6 | 57.93 | 11.6 | 83.05 | 8.6 | 70.52 | 11.6 | 7.09 |
| 65.5 | 142.79 | 13.8 | 58.78 | 11.8 | 84.43 | 8.8 | 72.16 | 11.8 | 7.22 |
| 66 | 143.88 | 14 | 59.64 | 12 | 85.92 | 9 | 73.80 | 12 | 7.34 |
| 66.5 | 144.97 | 14.2 | 60.49 | 12.2 | 87.35 | 9.2 | 75.44 | 12.2 | 7.46 |
| 67 | 146.06 | 14.4 | 61.34 | 12.4 | 88.78 | 9.4 | 77.03 | 12.4 | 7.58 |
| 67.5 | 147.15 | 14.6 | 62.19 | 12.6 | 90.21 | 9.6 | 78.72 | 12.6 | 7.71 |
| 68 | 148.44 | 14.8 | 63.04 | 12.8 | 91.64 | 9.8 | 80.36 | 12.8 | 7.83 |
| 68.5 | 149.33 | 15 | 63.90 | 13 | 93.03 | 10 | 82 | 13 | 7.95 |
| 69 | 150.42 | 15.2 | 64.75 | 13.2 | 94.51 | 10.2 | 83.64 | 13.2 | 8.07 |
| 69.5 | 151.51 | 15.4 | 65.60 | 13.4 | 95.94 | 10.4 | 85.28 | 13.4 | 8.20 |
| 70 | 152.60 | 15.6 | 66.45 | 13.6 | 97.37 | 10.6 | 86.22 | 13.6 | 8.32 |
| 70.5 | 153.69 | 15.8 | 67.30 | 13.8 | 98.80 | 10.8 | 88.56 | 13.8 | 8.44 |
| 71 | 154.78 | 16 | 68.16 | 14 | 100.24 | 11 | 90.20 | 14 | 8.56 |
| 71.5 | 155.87 | 16.2 | 69.01 | 14.2 | 101.67 | 11.2 | 91.84 | 14.2 | 8.69 |
| 72 | 156.90 | 16.4 | 69.86 | 14.4 | 103.10 | 11.4 | 93.48 | 14.4 | 8.81 |
| 72.5 | 158.05 | 16.6 | 70.71 | 14.6 | 104.53 | 11.6 | 95.12 | 14.6 | 8.93 |
| 73 | 159.14 | 16.8 | 71.56 | 14.8 | 105.95 | 11.8 | 96.76 | 14.8 | 9.05 |
| 73.5 | 160.23 | 17 | 72.42 | 15 | 107.40 | 12 | 98.40 | 15 | 9.18 |
| 74 | 161.33 | 17.2 | 73.27 | | | | | | |
| 74.5 | 162.41 | 17.4 | 74.12 | | | | | | |
| 75 | 163.50 | 17.6 | 74.97 | | | | | | |
| 75.5 | 164.59 | 17.8 | 75.82 | | | | | | |
| 76 | 165.68 | 18 | 76.68 | | | | | | |

## TABLE VII

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 20½-YEAR-OLD GROUP

*Formula:* Weight = 2.16 Ht. + 6.28 Sh. W. + 8.08 Ch. W. + 7.50 Ch. D. + 1.30 Hip W. — 257.29

| Ht. in .5″ | Ht. x 2.16 | Sh. W. in .2″ | Sh. W. x 6.28 | Ch. W. in .2″ | Ch. W. x 8.08 | Ch. D. in .2″ | Ch. D. x 7.50 | Hip W. in .2″ | Hip W. x 1.30 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 120.96 | 10 | 62.80 | 8 | 64.64 | 5 | 37.50 | 8 | 10.40 |
| 56.5 | 122.04 | 10.2 | 64.05 | 8.2 | 66.25 | 5.2 | 39 | 8.2 | 10.66 |
| 57 | 123.12 | 10.4 | 65.31 | 8.4 | 67.87 | 5.4 | 40.50 | 8.4 | 10.92 |
| 57.5 | 124.20 | 10.6 | 66.56 | 8.6 | 69.48 | 5.6 | 42 | 8.6 | 11.18 |
| 58 | 125.28 | 10.8 | 67.82 | 8.8 | 71.10 | 5.8 | 43.50 | 8.8 | 11.44 |
| 58.5 | 126.36 | 11 | 69.08 | 9 | 72.72 | 6 | 45 | 9 | 11.70 |
| 59 | 127.44 | 11.2 | 70.33 | 9.2 | 74.33 | 6.2 | 46.50 | 9.2 | 11.96 |
| 59.5 | 128.52 | 11.4 | 71.59 | 9.4 | 75.95 | 6.4 | 48 | 9.4 | 12.22 |
| 60 | 129.60 | 11.6 | 72.84 | 9.6 | 77.56 | 6.6 | 49.50 | 9.6 | 12.48 |
| 60.5 | 130.68 | 11.8 | 74.10 | 9.8 | 79.18 | 6.8 | 51 | 9.8 | 12.74 |
| 61 | 131.76 | 12 | 75.36 | 10 | 80.80 | 7 | 52.50 | 10 | 13 |
| 61.5 | 132.84 | 12.2 | 76.61 | 10.2 | 82.41 | 7.2 | 54 | 10.2 | 13.26 |
| 62 | 133.92 | 12.4 | 77.87 | 10.4 | 84.03 | 7.4 | 55.50 | 10.4 | 13.52 |
| 62.5 | 135 | 12.6 | 79.12 | 10.6 | 85.64 | 7.6 | 57 | 10.6 | 13.78 |
| 63 | 136.08 | 12.8 | 80.38 | 10.8 | 87.36 | 7.8 | 58.50 | 10.8 | 14.04 |
| 63.5 | 137.16 | 13 | 81.64 | 11 | 88.88 | 8 | 60 | 11 | 14.30 |
| 64 | 138.24 | 13.2 | 82.89 | 11.2 | 90.49 | 8.2 | 61.50 | 11.2 | 14.56 |
| 64.5 | 139.32 | 13.4 | 84.15 | 11.4 | 92.11 | 8.4 | 63 | 11.4 | 14.82 |
| 65 | 140.40 | 13.6 | 85.40 | 11.6 | 93.72 | 8.6 | 64.50 | 11.6 | 15.08 |
| 65.5 | 141.48 | 13.8 | 86.66 | 11.8 | 95.34 | 8.8 | 66 | 11.8 | 15.34 |
| 66 | 143.56 | 14 | 87.92 | 12 | 96.96 | 9 | 67.50 | 12 | 15.60 |
| 66.5 | 143.64 | 14.2 | 89.17 | 12.2 | 98.57 | 9.2 | 69 | 12.2 | 15.86 |
| 67 | 144.72 | 14.4 | 90.43 | 12.4 | 100.19 | 9.4 | 70.50 | 12.4 | 16.12 |
| 67.5 | 145.80 | 14.6 | 91.68 | 12.6 | 101.80 | 9.6 | 72 | 12.6 | 16.38 |
| 68 | 146.88 | 14.8 | 92.94 | 12.8 | 103.42 | 9.8 | 73.50 | 12.8 | 16.64 |
| 68.5 | 147.96 | 15 | 94.20 | 13 | 105.04 | 10 | 75 | 13 | 16.90 |
| 69 | 149.04 | 15.2 | 95.45 | 13.2 | 106.65 | 10.2 | 76.50 | 13.2 | 17.16 |
| 69.5 | 150.12 | 15.4 | 96.71 | 13.4 | 108.27 | 10.4 | 78 | 13.4 | 17.42 |
| 70 | 151.20 | 15.6 | 97.96 | 13.6 | 109.88 | 10.6 | 79.50 | 13.6 | 17.68 |
| 70.5 | 152.28 | 15.8 | 99.22 | 13.8 | 111.50 | 10.8 | 81 | 13.8 | 17.94 |
| 71 | 153.56 | 16 | 100.48 | 14 | 113.12 | 11 | 82.50 | 14 | 18.20 |
| 71.5 | 154.44 | 16.2 | 101.73 | 14.2 | 114.73 | 11.2 | 84 | 14.2 | 18.46 |
| 72 | 155.52 | 16.4 | 102.99 | 14.4 | 116.35 | 11.4 | 85.50 | 14.4 | 18.72 |
| 72.5 | 156.60 | 16.6 | 104.24 | 14.6 | 117.96 | 11.6 | 87 | 14.6 | 18.98 |
| 73 | 157.68 | 16.8 | 105.50 | 14.8 | 119.58 | 11.8 | 88.50 | 14.8 | 19.24 |
| 73.5 | 158.76 | 17 | 106.76 | 15 | 121.20 | 12 | 90 | 15 | 19.50 |
| 74 | 159.84 | 17.2 | 108.01 | | | | | | |
| 74.5 | 160.92 | 17.4 | 109.27 | | | | | | |
| 75 | 162 | 17.6 | 110.52 | | | | | | |
| 75.5 | 163.08 | 17.8 | 111.78 | | | | | | |
| 76 | 164.16 | 18 | 113.04 | | | | | | |

## TABLE VIII

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 21½-YEAR-OLD GROUP

*Formula:* Weight = 1.08 Ht. + 5.25 Sh. W. + 8.37 Ch. W. + 9.09 Ch. D. + 5.7 Hip W. — 229.33

| Ht. in .5″ | Ht. x 1.08 | Sh. W. in .2″ | Sh. W. x 5.25 | Ch. W. in .2″ | Ch. W. x 8.37 | Ch. D. in .2″ | Ch. D. x 9.09 | Hip W. in .2″ | Hip W. x 5.7 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 60.48 | 10 | 52.50 | 8 | 66.96 | 5 | 45.45 | 8 | 45.68 |
| 56.5 | 61.02 | 10.2 | 53.55 | 8.2 | 68.63 | 5.2 | 47.26 | 8.2 | 46.82 |
| 57 | 61.56 | 10.4 | 54.60 | 8.4 | 70.30 | 5.4 | 49.08 | 8.4 | 47.96 |
| 57.5 | 62.10 | 10.6 | 55.65 | 8.6 | 71.98 | 5.6 | 50.90 | 8.6 | 49.10 |
| 58 | 62.64 | 10.8 | 56.70 | 8.8 | 73.65 | 5.8 | 52.72 | 8.8 | 50.24 |
| 58.5 | 63.18 | 11 | 57.75 | 9 | 75.33 | 6 | 54.54 | 9 | 51.39 |
| 59 | 63.72 | 11.2 | 58.80 | 9.2 | 77 | 6.2 | 56.35 | 9.2 | 52.53 |
| 59.5 | 64.26 | 11.4 | 59.85 | 9.4 | 78.67 | 6.4 | 58.17 | 9.4 | 53.67 |
| 60 | 64.80 | 11.6 | 60.90 | 9.6 | 80.35 | 6.6 | 59.99 | 9.6 | 54.81 |
| 60.5 | 65.34 | 11.8 | 61.95 | 9.8 | 82.02 | 6.8 | 61.81 | 9.8 | 55.95 |
| 61 | 65.88 | 12 | 63 | 10 | 83.70 | 7 | 63.63 | 10 | 57.10 |
| 61.5 | 66.42 | 12.2 | 64.05 | 10.2 | 85.37 | 7.2 | 65.44 | 10.2 | 58.24 |
| 62 | 66.96 | 12.4 | 65.10 | 10.4 | 87.04 | 7.4 | 67.26 | 10.4 | 59.38 |
| 62.5 | 67.50 | 12.6 | 66.15 | 10.6 | 88.72 | 7.6 | 69.08 | 10.6 | 60.52 |
| 63 | 68.04 | 12.8 | 67.20 | 10.8 | 90.39 | 7.8 | 70.90 | 10.8 | 61.66 |
| 63.5 | 68.58 | 13 | 68.25 | 11 | 92.07 | 8 | 72.72 | 11 | 62.81 |
| 64 | 69.12 | 13.2 | 69.30 | 11.2 | 93.74 | 8.2 | 74.53 | 11.2 | 63.95 |
| 64.5 | 69.66 | 13.4 | 70.35 | 11.4 | 95.41 | 8.4 | 76.35 | 11.4 | 65.09 |
| 65 | 70.20 | 13.6 | 71.40 | 11.6 | 97.09 | 8.6 | 78.17 | 11.6 | 66.23 |
| 65.5 | 70.74 | 13.8 | 72.45 | 11.8 | 98.76 | 8.8 | 79.99 | 11.8 | 67.37 |
| 66 | 71.28 | 14 | 73.50 | 12 | 100.44 | 9 | 81.81 | 12 | 88.52 |
| 66.5 | 71.82 | 14.2 | 74.55 | 12.2 | 102.11 | 9.2 | 83.62 | 12.2 | 69.66 |
| 67 | 72.36 | 14.4 | 75.60 | 12.4 | 103.78 | 9.4 | 85.44 | 12.4 | 70.80 |
| 67.5 | 72.90 | 14.6 | 76.65 | 12.6 | 105.46 | 9.6 | 87.21 | 12.6 | 71.94 |
| 68 | 73.44 | 14.8 | 77.70 | 12.8 | 107.13 | 9.8 | 89.08 | 12.8 | 73.08 |
| 68.5 | 73.98 | 15 | 78.75 | 13 | 108.81 | 10 | 90.90 | 13 | 74.23 |
| 69 | 74.52 | 15.2 | 79.80 | 13.2 | 110.48 | 10.2 | 92.71 | 13.2 | 75.37 |
| 69.5 | 75.06 | 15.4 | 80.85 | 13.4 | 112.15 | 10.4 | 94.53 | 13.4 | 76.51 |
| 70 | 75.60 | 15.6 | 81.90 | 13.6 | 113.83 | 10.6 | 96.35 | 13.6 | 77.65 |
| 70.5 | 76.14 | 15.8 | 82.95 | 13.8 | 115.50 | 10.8 | 98.17 | 13.8 | 78.79 |
| 71 | 76.68 | 16 | 84 | 14 | 117.18 | 11 | 99.99 | 14 | 79.94 |
| 71.5 | 77.22 | 16.2 | 85.05 | 14.2 | 118.85 | 11.2 | 101.80 | 14.2 | 81.08 |
| 72 | 77.76 | 16.4 | 86.10 | 14.4 | 120.52 | 11.4 | 103.62 | 14.4 | 82.22 |
| 72.5 | 78.30 | 16.6 | 87.15 | 14.6 | 122.20 | 11.6 | 105.44 | 14.6 | 83.36 |
| 73 | 78.84 | 16.8 | 88.20 | 14.8 | 123.87 | 11.8 | 107.26 | 14.8 | 84.50 |
| 73.5 | 79.38 | 17 | 89.25 | 15 | 125.55 | 12 | 109.08 | 15 | 85.65 |
| 74 | 79.92 | 17.2 | 90.30 | | | | | | |
| 74.5 | 80.46 | 17.4 | 91.35 | | | | | | |
| 75 | 81 | 17.6 | 92.40 | | | | | | |
| 75.5 | 81.54 | 17.8 | 93.45 | | | | | | |
| 76 | 82.08 | 18 | 94.50 | | | | | | |

## TABLE IX

THE MULTIPLICATIONS OF EACH OF THE SKELETAL MEASURES, ACCORDING TO THE FORMULA FOR 22½-YEAR-OLD GROUP

*Formula:* Weight = 2.23 Ht. + .489 Sh. W. + 13.4 Ch. W. + 9.43 Ch. D. — 1.34 Hip W. —214.154

| Ht. in .5″ | Ht. x 2.23 | Sh. W. in .2″ | Sh. W. x .489 | Ch. W. in .2″ | Ch. W. x 13.4 | Ch. D. in .2″ | Ch. D. x 9.43 | Hip W. in .2″ | Hip W. x 1.34 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | 124.88 | 10 | 4.89 | 8 | 107.36 | 5 | 47.15 | 8 | 10.72 |
| 56.5 | 125.99 | 10.2 | 4.987 | 8.2 | 110.04 | 5.2 | 49.08 | 8.2 | 10.98 |
| 57 | 127.11 | 10.4 | 5.085 | 8.4 | 112.72 | 5.4 | 50.92 | 8.4 | 11.25 |
| 57.5 | 128.22 | 10.6 | 5.183 | 8.6 | 115.41 | 5.6 | 52.80 | 8.6 | 11.52 |
| 58 | 129.34 | 10.8 | 5.281 | 8.8 | 118.09 | 5.8 | 54.69 | 8.8 | 11.79 |
| 58.5 | 130.45 | 11 | 5.379 | 9 | 120.78 | 6 | 56.58 | 9 | 12.06 |
| 59 | 131.57 | 11.2 | 54.76 | 9.2 | 123.46 | 6.2 | 58.46 | 9.2 | 12.32 |
| 59.5 | 132.68 | 11.4 | 5.574 | 9.4 | 126.14 | 6.4 | 60.35 | 9.4 | 12.59 |
| 60 | 133.80 | 11.6 | 5.672 | 9.6 | 128.83 | 6.6 | 62.23 | 9.6 | 12.86 |
| 60.5 | 134.91 | 11.8 | 5.770 | 9.8 | 131.51 | 6.8 | 64.12 | 9.8 | 13.13 |
| 61 | 136.03 | 12 | 5.868 | 10 | 134.20 | 7 | 66.01 | 10 | 13.40 |
| 61.5 | 137.14 | 12.2 | 5.965 | 10.2 | 136.88 | 7.2 | 67.89 | 10.2 | 13.66 |
| 62 | 138.26 | 12.4 | 6.063 | 10.4 | 139.56 | 7.4 | 69.78 | 10.4 | 13.93 |
| 62.5 | 139.37 | 12.6 | 6.161 | 10.6 | 142.25 | 7.6 | 71.66 | 10.6 | 14.20 |
| 63 | 140.49 | 12.8 | 6.259 | 10.8 | 144.93 | 7.8 | 73.55 | 10.8 | 14.47 |
| 63.5 | 141.60 | 13 | 6.357 | 11 | 147.62 | 8. | 75.44 | 11 | 14.74 |
| 64 | 142.72 | 13.2 | 6.454 | 11.2 | 150.30 | 8.2 | 77.32 | 11.2 | 15 |
| 64.5 | 143.83 | 13.4 | 6.552 | 11.4 | 152.98 | 8.4 | 79.21 | 11.4 | 15.27 |
| 65 | 144.95 | 13.6 | 6.650 | 11.6 | 155.67 | 8.6 | 81.09 | 11.6 | 15.54 |
| 65.5 | 146.06 | 13.8 | 6.748 | 11.8 | 158.35 | 8.8 | 82.98 | 11.8 | 15.81 |
| 66 | 147.18 | 14 | 6.846 | 12 | 161.04 | 9 | 84.87 | 12 | 16.08 |
| 66.5 | 148.29 | 14.2 | 6.943 | 12.2 | 163.72 | 9.2 | 86.75 | 12.2 | 16.34 |
| 67 | 149.41 | 14.4 | 7.041 | 12.4 | 166.40 | 9.4 | 88.64 | 12.4 | 16.61 |
| 67.5 | 150.52 | 14.6 | 7.139 | 12.6 | 169.09 | 9.6 | 90.52 | 12.6 | 16.88 |
| 68 | 151.64 | 14.8 | 7.237 | 12.8 | 171.77 | 9.8 | 92.41 | 12.8 | 17.15 |
| 68.5 | 152.75 | 15 | 7.335 | 13 | 174.46 | 10 | 94.30 | 13 | 17.42 |
| 69 | 153.87 | 15.2 | 7.432 | 13.2 | 177.14 | 10.2 | 96.18 | 13.2 | 17.68 |
| 69.5 | 154.98 | 15.4 | 7.530 | 13.4 | 179.82 | 10.4 | 98.07 | 13.4 | 17.95 |
| 70 | 156.10 | 15.6 | 7.628 | 13.6 | 182.51 | 10.6 | 99.95 | 13.6 | 18.22 |
| 70.5 | 157.21 | 15.8 | 7.726 | 13.8 | 185.19 | 10.8 | 101.84 | 13.8 | 18.49 |
| 71 | 158.33 | 16 | 7.834 | 14 | 187.88 | 11 | 103.73 | 14 | 18.76 |
| 71.5 | 159.44 | 16.2 | 7.921 | 14.2 | 190.56 | 11.2 | 105.61 | 14.2 | 19.02 |
| 72 | 160.56 | 16.4 | 8.019 | 14.4 | 193.24 | 11.4 | 107.50 | 14.4 | 19.29 |
| 72.5 | 161.67 | 16.6 | 8.117 | 14.6 | 193.93 | 11.6 | 109.38 | 14.6 | 19.56 |
| 73 | 162.79 | 16.8 | 8.215 | 14.8 | 198.61 | 11.8 | 111.27 | 14.8 | 19.83 |
| 73.5 | 163.90 | 17 | 8.313 | 15 | 201.30 | 12 | 113.16 | 15 | 20.10 |
| 74 | 165.02 | 17.2 | 8.410 | | | | | | |
| 74.5 | 166.13 | 17.4 | 8.508 | | | | | | |
| 75 | 167.25 | 17.6 | 8.606 | | | | | | |
| 75.5 | 168.36 | 17.8 | 8.704 | | | | | | |
| 76 | 169.48 | 18 | 8.802 | | | | | | |

## CONCLUSIONS

The present study has sought to investigate body weight in relation to certain skeletal measurements, as determined by an examination of college men between the ages of sixteen and twenty-two. The following conclusions have been reached:

1. The zero order correlations between the weight and the skeletal measurements—height, chest width, chest depth, shoulder width, and hip width—are not sufficiently high to indicate that any one of these skeletal measures could be used alone to give an accurate prediction of weight.

2. In the zero order correlations, there is no one measurement having the highest correlation in all age groups. Chest width, which has the highest correlation in the groups between the ages of eighteen and twenty-two, would be in general the best single measurement for weight prediction.

3. As judged by the zero order correlations, hip width is the factor which has the least value in weight prediction, throughout all the age groups.

4. The zero order correlations of the various skeletal measurements do not vary greatly in size. This indicates that all these measurements combined, rather than any single factor, should be taken into account in predicting the weight.

5. The percentage value of each of the five skeletal measurements would indicate: (*a*) that no one measurement affords the most accurate index to weight prediction at all ages: (*b*) that, in general, chest width, chest depth, and height have the highest percentage of accuracy in weight prediction; (*c*) that the percentages of accuracy shown by shoulder width are noticeably high at all ages, except in the group twenty-two and one-half years old; (*d*) that, in general, hip width is the measurement which has the least significance in weight prediction.

6. From an examination of the zero order correlation and the percentage values in weight prediction, it is clear that at least three, and preferably all five, of the skeletal measurements should be employed as an index to weight, since their influence upon the weight is obviously significant.

7. The multiple correlations between weight and the 5 skeletal measurements range from .892, in the 16¼-year-old group, to .736, in the 22½-year-old group. These multiples are hardly large enough to account for all the variations in weight, but they do serve to show that many of these variations are due, not to "overweight" or "underweight" (as indicated by the height-weight tables), but to differences in skeletal build.

8. An examination of the relative value of various combinations of skeletal measurements, as an index to weight, indicates: (*a*) that no

combination of factors—except, of course, that which includes all the five measurements—gives the most accurate index for all the age groups; (*b*) that in all the age groups (except those of sixteen and one-quarter and twenty-one and one-half years) the most valid combination of three factors will include chest width, chest depth, and height; (*c*) that even in the groups sixteen and three-quarters and twenty-one and one-half years, of age, the value of this combination of three measurements is very high; (*d*) that at least three, and preferably five, skeletal measurements should be combined in order to secure a basis for accurate prediction of weight.

9. Through the use of the regression equations, employing a combination of five skeletal measurements, weight may be predicted much more accurately than through the use of any single measurement. The amount of deviation from the predicted weight, occurring when such an equation is used, is approximately 25 per cent less than that which occurs when only one measurement is used.

10. Through the regression equations it is possible to predict any one of the five skeletal measures. Variations from these predictions may or may not be important; their significance must be determined by use. Such predictions may be of value in the diagnosis of chest diseases, and in the prescribing of physical education activities.

11. In itself the prediction of weight has no particular importance. What is significant is the explanation of differences in weight as being due to variation in skeletal build. It is obvious that weight variations which can be thus accounted for are not to be used as an index of the state of health or of nutrition. When due allowance has been made for variations in weight owing to the differences in skeletal build, then any remaining differences between the actual weight and the weight as predicted from the skeletal build must be accounted for in other ways, and may be indications of the state of health or of nutrition.

## INTERPRETATIONS OF CONCLUSIONS

For a long time the individual's weight, taken in conjunction with his height, has been considered an index of the state of health and of nutrition. Much confidence has been placed in tables showing exactly what the individual should weigh, and many persons have sought to make themselves over so that they would approximate the normal weight.

There has been a growing dissatisfaction with these weight-indexing tables because so many individuals vary greatly from what these tables indicate should be their normal weight. The findings obtained through the present study indicate that a weight-index table which is made up from one skeletal measurement, such as height, could not possibly give a close index of what all types of individuals should weigh. Further-

more, each of the five skeletal measurements studied is important enough in its effect upon body weight so that it should be used in a weight-index table.

The use of the formulas of this study for predicting weight are recommended. Any individuals who vary greatly from the predictions of the equations made on the basis of these five skeletal measurements are, when compared with their skeletal peers, too heavy or too light in weight. These individuals, who will ordinarily form only a very small proportion of any given group, should be given a careful examination and should be placed under observation for change in body weight over a fixed period of time.

Individuals who appear to be overweight, underweight, or markedly unusual in build, should be tested by the use of the regression equations, in order to determine whether their cases are actually different or whether they only appear to be so. Out of every 200 who are 10 per cent overweight or underweight by the height-weight tables, the present formulas will show that 100 to 150 of these individuals weigh what would normally be expected for their skeletal builds.

The investigator feels that the use of the height-weight tables is both useless and harmful. The tables indicate what all individuals should weigh and yet they can not possibly give even a fair index. Because of these inaccurate tables people try to gain or lose weight. Medical men, physical directors, teachers, and others are continually informing the public that they are underweight or overweight. A little observation of the skeletal builds of people will soon convince one that the single measurement of height as an index of body weight is but little short of absurd. The investigator feels that this point can not be emphasized too strongly and repeats that the single measurement of height as an index of weight is useless and harmful. It is easy to take but worthless. The present formulas will take a little more time but will take into consideration the skeletal type, and hence will give a fair index of what the body weight should be. The chart on page 94 gives very clearly the importance of each of the five skeletal factors in body weight. None of the factors can be ignored in making a formula for estimating the body weight.

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# Weight Variation Percentage Chart

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## FOREWORD

THE PERCENTAGE chart was compiled for the specific purpose of securing greater speed and accuracy in computing weight variation. A height-weight chart has purposely been omitted in order that the examiner may use the scale most acceptable to her.

The range of figures used for height and weight will limit the use of the chart but should provide for the greater majority of girls and women above the first year in high school.

It is assumed that the use of a numerical representation of weight variation, such as percentage of variation or pounds over or under, is of value only when considered in the light of the individual's hereditary build and constitution.

## STATEMENT CONCERNING THE USE OF THE CHART

By Shirley Armstrong, M.D.
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THE percentage of variation in weight is of value where large numbers of students are to be examined because when used in conjunction with other findings in the examination it serves to indicate which students need special supervision in attempting to lose or gain weight. If a student is 15 per cent underweight or 20 per cent overweight, then the student is given special consideration in order that any pathological condition or improper hygiene habits may be ruled out before assuming that it is normal for the student to vary that much from the average.

Percentage of variation is not in itself considered pathological unless other symptoms or physical findings are present. However, it is in many cases a very valuable indication of some underlying cause, such as a focus of infection, a glandular disturbance, overwork, or improper diet or habits of eating.

The percentage of variation has served as an important indication in choosing students for special nutrition classes at Ohio State University. These classes are conducted through the cooperation of the

| Pounds over or under-Weight | 80 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 6 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 7 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 |
| 8 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 |
| 9 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10 | 13 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 |
| 11 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 |
| 12 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 13 |
| 13 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 |
| 14 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 |
| 15 | 19 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 |
| 16 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 |
| 17 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 19 | 19 | 19 |
| 18 | 23 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 20 | 20 |
| 19 | 24 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 21 | 21 |
| 20 | 25 | 25 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 22 |
| 21 | 26 | 26 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 |
| 22 | 27 | 27 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 |
| 23 | 29 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 |
| 24 | 30 | 30 | 29 | 29 | 28 | 28 | 28 | 28 | 27 | 27 |
| 25 | 31 | 31 | 30 | 30 | 30 | 29 | 29 | 29 | 28 | 28 |
| 26 | 33 | 32 | 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 |
| 27 | 34 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 30 |
| 28 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 |
| 29 | 36 | 35 | 35 | 35 | 35 | 34 | 34 | 33 | 33 | 33 |
| 30 | 38 | 37 | 36 | 36 | 36 | 35 | 35 | 34 | 34 | 34 |
| 31 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 35 |
| 32 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 36 |
| 33 | 41 | 40 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 |
| 34 | 43 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 |
| 35 | 44 | 43 | 42 | 42 | 42 | 41 | 41 | 40 | 40 | 39 |
| 36 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 |
| 37 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 |
| 38 | 48 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 |
| 39 | 49 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 |
| 40 | 50 | 49 | 48 | 48 | 48 | 47 | 46 | 46 | 45 | 45 |
| 41 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 46 | 46 |
| 42 | 53 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 47 | 47 |
| 43 | 54 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 48 |
| 44 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 |
| 45 | 56 | 55 | 54 | 54 | 54 | 53 | 52 | 52 | 51 | 51 |
| 46 | 58 | 56 | 56 | 55 | 55 | 54 | 53 | 53 | 52 | 52 |
| 47 | 59 | 58 | 57 | 56 | 56 | 56 | 55 | 54 | 53 | 53 |
| 48 | 60 | 59 | 58 | 58 | 57 | 57 | 56 | 55 | 54 | 54 |
| 49 | 61 | 60 | 59 | 59 | 58 | 57 | 57 | 56 | 55 | 55 |
| 50 | 62 | 61 | 60 | 60 | 59 | 58 | 58 | 57 | 56 | 56 |

| Pounds over or under-Weight | 90 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 7 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 8 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 |
| 9 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 |
| 10 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 |
| 11 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 |
| 12 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 |
| 13 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 |
| 14 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 |
| 15 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 |
| 16 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 |
| 17 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 17 | 17 |
| 18 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 18 | 18 |
| 19 | 22 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 19 | 19 |
| 20 | 23 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 20 | 20 |
| 21 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 22 | 22 | 22 |
| 22 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 23 | 23 |
| 23 | 27 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 24 |
| 24 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 |
| 25 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 27 | 27 | 27 |
| 26 | 31 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 |
| 27 | 32 | 32 | 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 |
| 28 | 33 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 30 |
| 29 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 |
| 30 | 36 | 36 | 35 | 35 | 35 | 34 | 34 | 34 | 33 | 33 |
| 31 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 34 | 34 |
| 32 | 39 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 35 |
| 33 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 37 | 36 |
| 34 | 41 | 41 | 41 | 40 | 40 | 40 | 39 | 39 | 38 | 38 |
| 35 | 43 | 42 | 42 | 42 | 41 | 41 | 41 | 40 | 40 | 39 |
| 36 | 44 | 44 | 43 | 43 | 42 | 42 | 42 | 41 | 41 | 41 |
| 37 | 45 | 45 | 45 | 44 | 44 | 43 | 43 | 43 | 42 | 42 |
| 38 | 47 | 46 | 46 | 46 | 45 | 45 | 44 | 44 | 44 | 43 |
| 39 | 48 | 48 | 47 | 47 | 47 | 46 | 46 | 45 | 45 | 45 |
| 40 | 49 | 49 | 49 | 48 | 48 | 48 | 47 | 47 | 46 | 46 |
| 41 | 51 | 50 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 |
| 42 | 52 | 52 | 51 | 51 | 51 | 50 | 50 | 49 | 49 | 48 |
| 43 | 53 | 53 | 53 | 52 | 52 | 52 | 51 | 51 | 50 | 50 |
| 44 | 54 | 54 | 54 | 54 | 53 | 53 | 53 | 52 | 52 | 51 |
| 45 | 56 | 55 | 55 | 55 | 54 | 54 | 54 | 53 | 53 | 52 |
| 46 | 57 | 57 | 56 | 56 | 56 | 55 | 55 | 55 | 54 | 54 |
| 47 | 58 | 58 | 58 | 57 | 57 | 57 | 56 | 56 | 56 | 55 |
| 48 | 60 | 59 | 59 | 59 | 58 | 58 | 58 | 57 | 57 | 57 |
| 49 | 61 | 61 | 60 | 60 | 60 | 59 | 59 | 59 | 58 | 58 |
| 50 | 62 | 62 | 62 | 61 | 61 | 61 | 60 | 60 | 60 | 59 |

| Pounds over or under-Weight | 100 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 |
| 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 |
| 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 |
| 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 |
| 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 |
| 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 |
| 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 |
| 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 |
| 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 15 |
| 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 |
| 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 |
| 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 |
| 21 | 21 | 21 | 21 | 20 | 20 | 20 | 19 | 19 | 19 | 19 |
| 22 | 22 | 22 | 22 | 21 | 21 | 21 | 20 | 20 | 20 | 20 |
| 23 | 23 | 23 | 23 | 22 | 22 | 22 | 21 | 21 | 21 | 21 |
| 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 22 | 22 | 22 |
| 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 23 | 23 | 23 |
| 26 | 26 | 26 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 |
| 27 | 27 | 27 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 |
| 28 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 |
| 29 | 29 | 29 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 26 |
| 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 27 |
| 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 |
| 32 | 32 | 32 | 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 |
| 33 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 30 | 30 |
| 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 | 31 | 31 |
| 35 | 35 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 |
| 36 | 36 | 36 | 35 | 35 | 35 | 34 | 34 | 33 | 33 | 33 |
| 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 34 | 34 | 34 |
| 38 | 38 | 38 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 |
| 39 | 39 | 39 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 35 |
| 40 | 40 | 40 | 39 | 39 | 38 | 38 | 38 | 37 | 37 | 36 |
| 41 | 41 | 41 | 40 | 40 | 39 | 39 | 39 | 38 | 38 | 37 |
| 42 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 |
| 43 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 40 | 39 |
| 44 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 |
| 45 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 |
| 46 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 |
| 47 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 |
| 48 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 |
| 49 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 |
| 50 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 47 | 47 |

| Pounds over or under-Weight | 110 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 |
| 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 |
| 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 13 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 14 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 15 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| 16 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 |
| 17 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 |
| 18 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 |
| 19 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 |
| 20 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 |
| 21 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| 22 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 |
| 23 | 21 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 |
| 24 | 22 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 |
| 25 | 23 | 23 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 |
| 26 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 |
| 27 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 |
| 28 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 |
| 29 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 24 | 24 |
| 30 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 25 | 25 |
| 31 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 |
| 32 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 |
| 33 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 |
| 34 | 31 | 31 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 29 |
| 35 | 32 | 32 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 30 |
| 36 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 30 |
| 37 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 31 | 31 |
| 38 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 32 | 32 | 32 |
| 39 | 35 | 35 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 33 |
| 40 | 36 | 36 | 36 | 35 | 35 | 34 | 34 | 34 | 34 | 34 |
| 41 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 34 | 34 |
| 42 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 |
| 43 | 39 | 39 | 38 | 38 | 38 | 37 | 37 | 36 | 36 | 36 |
| 44 | 40 | 40 | 39 | 39 | 38 | 38 | 38 | 37 | 37 | 37 |
| 45 | 41 | 41 | 40 | 40 | 40 | 39 | 39 | 39 | 38 | 38 |
| 46 | 41 | 41 | 41 | 40 | 40 | 40 | 40 | 39 | 39 | 39 |
| 47 | 42 | 42 | 42 | 41 | 41 | 40 | 40 | 40 | 39 | 39 |
| 48 | 43 | 43 | 43 | 42 | 42 | 41 | 41 | 41 | 40 | 40 |
| 49 | 44 | 44 | 44 | 43 | 43 | 42 | 42 | 42 | 41 | 41 |
| 50 | 45 | 45 | 45 | 44 | 44 | 43 | 43 | 43 | 42 | 42 |

The above percentage table can be used with any height-weight chart to find the
each individual. The usual procedure is as follows: (1) Find the actual weight; (2) L
difference between correct and actual weight; (4) Divide difference by correct weight.
difference, +17; 17/133=13 per cent overweight.

In using the above chart steps 1, 2, and 3 are the same. Instead of dividing the diff
in the extreme left column and follow across to the correct weight (133) and the percen

n Pounds

| | 120 | | | | | | | | | | 130 | | | | | | | | | | 140 | | | | | | | | | | 150 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 09 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 00 | 01 | 02 | 03 | 04 | 05 |
| 1 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | | | | | |
| 5 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 6 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 7 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 8 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 9 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 0 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 1 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| 2 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 3 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 4 14 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 12 | 12 | 12 | 12 | 12 |
| 5 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| 6 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| 7 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| 8 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| 9 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| 0 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| 1 21 | 21 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 |
| 2 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| 3 23 | 23 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| 4 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| 5 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 19 |
| 6 26 | 26 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| 7 27 | 27 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| 8 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| 9 30 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| 0 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| 1 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| 2 32 | 32 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| 3 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| 4 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| 5 35 | 35 | 34 | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| 6 36 | 36 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 |
| 7 37 | 37 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 8 38 | 38 | 37 | 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 |
| 9 39 | 39 | 38 | 38 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| 0 40 | 40 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 37 | 37 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 1 41 | 41 | 40 | 40 | 40 | 39 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 38 | 37 | 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
| 2 42 | 42 | 41 | 41 | 41 | 41 | 40 | 40 | 40 | 39 | 39 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |

t to find the percentage of variation from the correct weight for
weight; (2) Look up the correct weight for height and age; (3) Get
rrect weight. For example: Actual weight 150; correct weight, 133;

viding the difference by the correct weight, find the difference (17)
and the percentage of variation (13) is easily found.

medical advisors, Department of Physical Education for Women, and the Home Economics Department. The students are given complete medical examinations (including laboratory work indicated as necessary) in order that any pathological conditions may be ruled out or treated. If the results of the examination indicate that the student's condition can be improved by supervised diet and exercise, she is given the opportunity to enroll in the special nutrition class mentioned above.

We have used the compiled chart of percentage of variation in examining approximately 1,600 women annually for the past two years and have found it a much faster and more accurate way of obtaining this variation that the former method of hand computation.

# A Study of State Physical Education Associations*

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## INTRODUCTION

With the rapid growth of state physical education associations since the World War, many problems have arisen as to the best plan of organization for these associations, in an effort to make them more efficient in furthering the interests of physical education within the state. Many of the older associations have undergone reorganization. Some of the more recently organized ones have copied the plans of the older associations, while others are following the modern trend in education. Since all but ten states have physical education associations, there is reason to believe that such general interest in these organizations indicates increased appreciation of the effectiveness of group action and some insight as to the part that such associations should play in raising the standard of physical education and promoting a state program.

It is with the purpose of presenting the present practices in the organizations and actitities of state physical education associations for comparison and evaluation that the present study is undertaken.** The findings of such a survey should prove helpful in assisting new organizations to utilize the plans and practices which have been tried and which have succeeded in other state physical education associations.

## SOURCES OF DATA

The chief source of data is the information obtained directly from the officers of the various state physical education associations, constitutions, news letters, programs, meetings, proceedings, and literature issued by these organizations which furnished a large part of the information for the study. Other data were obtained from the results of a questionnaire sent to the president of each of the thirty-eight state

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**The author wishes to express her appreciation for aid in the collection of the data used in this study to the officers of the state physical education associations, without which this study would not have been possible; to Dr. John T. Walquist for many valuable suggestions and criticisms in the organization of the study; to Miss Marguerite M. Schwarz, President of the Utah Physical Education Association, for valuable suggestions and assistance in collecting the data; to Dr. Leroy E. Cowles, for inspiration and encouragement in attempting the study.

associations. Replies to this questionnaire were received from thirty associations.

Additional information was obtained from the yearbooks and annual reports of the American Physical Education Association, and the *Handbook of the Mid-West Physical Education Society*.[1] Educational literature and reports of other investigations were used as cited in the body of the study. All together, information from thirty-two associations has furnished data for this study.

## PREVIOUS STUDIES

A survey of the state physical education associations of the Mid-West states has been compiled by the Mid-West Physical Education Association under the direction of Dr. C. O. Molander,[2] Secretary of the Mid-West Physical Education Association. This work consists of a mimeographed pamphlet containing a copy of a questionnaire as it was filled out by the physical education associations of the Mid-West states, and reports items of organization, such as membership, committees, and the like. No attempt was made to analyze the facts collected.

Dr. John Granrud [3] made a study in 1926 entitled "The Organization and Objectives of State Teachers' Associations," in which he analyzed the functions and objectives of state teachers' associations, and surveyed the organization and activities by which these associations are attempting to realize these functions and objectives.

## PRESENT STATUS OF STATE PHYSICAL EDUCATION ASSOCIATIONS

There are at the present time organizations of state physical education associations in thirty-nine states. These states are as follows: Alabama, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin.

From data received in reply to the inquiry blank sent out to all state physical education associations it was shown that the Michigan Association was the first to organize in 1896, followed by New York in 1912 and Wisconsin in 1916. There were no further organizations until after the World War, when in 1919 New Jersey organized an association. From that time growth was rapid and steady. The new ideals in

[1] C. O. Molander, *Handbook of the Mid-West Physical Education Association*, 1931-32, Chicago, Ill.: University of Chicago.

[2] *Ibid.*

[3] John Granrud, "The Organization and Objectives of State Teachers' Associations," *Contribution to Education*, No. 237, New York: Teachers College, Columbia University, 1926.

health and physical education following the war made it more necessary than ever before for physical education teachers to unite to formulate definite objectives and work together toward a common goal. Table I shows the dates of organization of twenty-eight associations.

Twenty-eight of the state associations are represented on the Legislative Council of the national organization, the American Physical Education Association. The national association has taken an active interest in the founding and growth of the state associations, particularly since 1930. At that time it was reorganized so that more emphasis was given to representation of state associations on the National Legislative Council.

At the present time state physical education societies may be represented on the Legislative Council of the American Physical Education Association by one representative for 25 national members, two representatives for 100 members, three representatives for 250 members, and four representatives for 500 members and over.[4]

Close relationships have always existed between the state associations and the American Physical Education Association. Not only has the national association been active in promoting the growth of the state organizations, but it has exerted considerable influence through its statements of aims and objectives.[5] The state associations have largely embodied these policies in drawing up their own constitutions. At the same time the state associations now wield a directing influence on the national association by their liberal representation on the National Legislative Council.

## THE PURPOSE OF STATE PHYSICAL EDUCATION ASSOCIATIONS

An analysis of the purposes of state physical education associations as defined in their constitutions shows that they have been organized for the general purpose of "promoting physical education, health, and recreation within the state." The tabulation of these purposes as they occurred in the constitutions of twenty-eight associations reveals that twenty-eight, or 100 per cent, are concerned with the promotion of physical education.

The objectives by means of which these twenty-eight organizations plan to realize their aim may be grouped under five general headings as follows:

Twenty-eight associations are concerned with the development of an adequate and unified state program of physical education.

Eleven associations are concerned with awakening a wide and intelligent interest in physical education and acquiring and disseminating knowledge of physical education to the general public.

[4] Elmer D. Mitchell, "The American Physical Education Association," *Journal of Health and Physical Education* (January, 1932), Pp. 3-7

[5] "Committee Report of the American Physical Education Association," *Journal of Health and Physical Education* (September, 1931), P. 25.

Seven associations are concerned with the training and provision of well-trained teachers and leadership in physical education.

Four associations are interested in advancing the social and professional status of teachers of physical education, the development of professional ethics, and the unification of the physical education teachers for mutual assistance and cooperation.

TABLE I

THE DATES OF ORGANIZATION OF TWENTY-EIGHT STATE PHYSICAL EDUCATION ASSOCIATIONS

| State Ass'n. | Year Organized | State Ass'n. | Year Organized |
|---|---|---|---|
| Michigan | 1896 | Rhode Island | 1924 |
| New York | 1912 | Virginia | 1925 |
| Wisconsin | 1916 | Alabama | 1926 |
| New Jersey | 1919 | North Dakota | 1927 |
| Connecticut | 1920 | New Hampshire | 1927 |
| Maryland | 1920 | Ohio | 1928 |
| Georgia | 1921 | South Carolina | 1928 |
| Iowa | 1921 | California | 1930 |
| North Carolina | 1921 | Colorado | 1931 |
| Oregon | 1921 | Illinois | 1931 |
| Pennsylvania | 1923 | Maine | 1931 |
| Texas | 1923 | Nebraska | 1931 |
| Oklahoma | 1924 | South Dakota | 1931 |
| Kentucky | 1924 | Utah | 1931 |

Four associations are concerned with the affiliation of the local association with the American Physical Education Association, and with state and other national educational agencies, in an effort to place physical education on a real educational basis.

In his study of state teachers' associations, Dr. John Granrud[6] ascertained from a survey of educational literature that the purpose of such associations is that of rendering a public service. He found that purposeful agencies were needed to improve conditions in the educational field, that the individual teacher had little influence, and that in order to secure effective action in a democracy there must be a group of individuals working with a common purpose, that with a unified body programs and policies can be formed and carried through to completion.

It would seem from a comparison of the purposes as set forth by twenty-eight state physical education associations with the purposes set forth by forty-six state teachers' associations that a close similarity of aims exists. Both organizations are interested primarily in (1) the promotion of education, and (2) in the advancement and improvement

[6] John Granrud, "The Organization and Objectives of State Teachers' Associations," *Contributions to Education No.* 234, New York: Teachers College, Columbia University, 1926.

of the group of teachers upon whom the final outcome of the undertaking depends.

## THE ORGANIZATION AND ADMINISTRATION OF STATE PHYSICAL EDUCATION ASSOCIATIONS

The purpose of this portion of the article is to show the present practices in vogue within the various state physical education associations with respect to their organization and administration. Also, in the following analysis of present tendencies an attempt has been made to indicate the trend in the relationships of the state associations with the American Physical Education Association, the State Education Associations, and the State Director of Physical Education.

The subject of control and organization will be discussed under the following headings: name of association, officers, committees, boards and councils, membership, dues, constitution, meetings, affiliation with other educational organizations, and the relation of the state director of physical education to the state association. The information was obtained through the study of the organization of thirty-two associations.

*Name.*—The reports from twenty-two associations show that the title "State Physical Education Association" is the one most commonly employed; for example, the Alabama State Physical Education Association. Two associations use the term "Physical Education Society"; for example, the Connecticut Physical Education Society. Six associations use the name "Health and Physical Education Association"; for example, the Kansas State Health and Physical Education Association. The term "society" is that used by the American Physical Education Association in referring to the state physical education organizations. However, since by the definition of the terms, the two words association and society are synonomous, the title is one of preference and does not connote any idea of variation in the organization of such groups. Out of twenty-four associations, twenty-two prefer the use of the term "association" and only two use the term "society."

The use of the name "Health and Physical Education Association" is perhaps a little more descriptive of the aims and objectives of the state groups using it, and follows the trend of more recent thinking in the physical education field. The misunderstanding and confusion of the aims and objectives of physical education by persons outside this field in regard to health have led to the use of the newer and more inclusive term, health and physical education. While the national association is still called the American Physical Education Association, it recently changed the title of its monthly publication from ***The American Physical Education Review*** to ***The Journal of Health and Physical Education***. One association uses the title "The California Association of Health, Physical Education, and Recreation" which is still more descrip-

tive. Another is called "The Ohio School Health and Physical Education Association," which by its name limits membership to those teachers connected with the schools. However, in actual practice this is not the case, so that this title would seem to be a misnomer.

*Officers.*—Thirty-two associations furnished the information concerning the number and combination of association officers. Twenty-one associations out of the thirty-two studied report that they have a president, vice-president, and secretary-treasurer; four associations have a president, two vice-presidents, and secretary-treasurer; four associations have a president, vice-president, secretary, and treasurer; three associations have a president, two vice-presidents, secretary, and treasurer; one association has only a president and secretary.

The customary duties of the officers are those provided for in Roberts' *Rules of Order* and common parliamentary practice. It was noted in the seven associations naming a second vice-president in their constitutions that while the duties of the other officers were specifically summarized, no mention at all was made of those of the second vice-president. If there is a duty for this officer to fulfill it should be stated. Otherwise if this officer is merely a figurehead it would be better to eliminate this office of second vice-president. The above figures show that a majority of associations evidently feel that their work can be carried on more efficiently with the three-officer arrangement, namely, a president, vice-president, and secretary-treasurer.

*Committees.*—Thirty associations were analyzed to show the number and types of committees which were elected or appointed to carry on the activities of the association. Eleven different standing committees were found to function in these thirty associations. Twenty-eight associations have an executive committee, three a nominating committee, fifteen a membership committee, thirteen a program committee, nine a publicity or press committee, nine a legislative committee (to promote legislation concerning physical education), three a research committee, one a finance committee, one a professional ethics committee, and one a social committee. Numerous other committees are appointed for special studies, investigations and the like.

*Legislative Council.*—Of the thirty associations studied, fourteen of them delegate governing power to a legislative council. This body is given broad powers to make laws for the conduct of the state association, plan the annual meeting, elect a representative to the legislative council of the American Physical Education Association, formulate policies, and the like. In the majority of cases the council is made up of the officers of the state association, one member elected from each district division, and the state director of physical education. Some states include the retiring local district presidents. Some specify that the district president shall be the representative to the council. One association allows one

representative for each twenty-five members, each member to have one vote. In one state the Council is appointed by the state director of physical education.

The majority of associations use the title Legislative or Executive Council, one association uses Legislative Senate, two use the name Executive Board, and one the Board of Directors.

In associations where there is no council, the executive committee assumes these governing functions. Fourteen associations have an executive committee, the average number on this committee being five. In all cases it is composed of the officers of the association and two or three members elected either by districts or at large.

The five associations mentioned below report both an executive committee and an executive council. The California association delegates to the Executive Committee the "right to suggest legislation to the Legislative Senate, and to put into effect the rules and regulations passed by that body." The Iowa association gives its executive committee the right "to transact routine business." Kansas does not state any specific duties for the executive committee although it provides for one in the constitution. No information from Michigan or New York, both of which have both a council and a committee, was available.

*Membership.*—In thirty-two associations studied with regard to membership, twenty-four reported that any one interested in the purpose of the association might become a member. Eight associations limited to certain groups. California makes provision for active and associate members. Active members with voting power are those actively engaged in teaching physical education. Associate members without voting power are those who are interested in physical education but are not actively employed as teachers. Texas and Ohio limit their membership to those teachers actively employed as members of a teaching staff of a school or organization. Michigan excepts physical education teachers in social agencies. Missouri excepts students. Both South Carolina and Tennessee except students and school administrators, and the former adds teachers in private schools to its list of exceptions.

The majority however feel that anyone who is sufficiently interested in the purpose of the state association to pay dues and attend meetings ought to be eligible to membership.

*Dues.*—Thirty-one associations report the amount of annual dues received. One dollar was the highest amount required in any association and twenty-five cents was the smallest amount. Twenty associations report one dollar dues, eight associations report fifty cents dues, one association reports twenty-five cents dues, and two associations, Ohio and Virginia, report that no dues are required. In the case of Ohio the constitution provides for a secretary-treasurer, part of whose duties it is to keep a record of all disbursements. The constitution does not indi-

cate the source of such money or how the association is financed. Virginia also reports that no dues are required, but provides a secretary-treasurer in its organization. California specifies that the dues of the association are not to exceed one dollar and that the dues collected support all segments of the state organization, the state receiving ten cents per member, the section twenty-five cents per member, and the balance to go to the local unit.

The amount of dues seems to be very small compared to the work that some of the associations are doing. It is difficult to see how news letters, bulletins, and publicity work can be financed from such small amounts.

*Membership in the A. P. E. A.*—From thirty-one replies regarding required membership in the American Physical Education Association, twenty-nine associations report that they do not require their members to become members in the A. P. E. A., although the majority add that it is strongly urged. Two associations, Maine and Pennsylvania, report that membership in the A. P. E. A. is required for all members of the state physical education association.

A state association must have twenty-five national members in order to be represented on the national council. This opportunity for representation is an incentive for state associations to encourage national membership among its members. It would seem that the present practice as shown by the replies of these thirty-one associations in making it desired but not required, is the best one to follow.

*The State Director of Physical Education.*—From thirty replies, fifteen associations report that their states have a state director of physical education and fifteen report that they have no state director. Seven associations report that the state director is an officer in the state association and eight report that he acts merely in an advisory capacity.

A state director of physical education is very much desired in most states. Many state associations of physical education have been instrumental in obtaining the services of such a person by means of legislation, and others are working toward this end. At the present time the office of state director in some states has been temporarily discontinued due to decreased budgets.

*Meetings.*—Thirty-two associations furnished the information concerning meetings of the state organizations and this will be analyzed under the following headings:

*a. Number of Meetings.*—Twenty-two associations hold one annual meeting; four associations meet twice a year; two associations meet three times a year; one association meets four times a year; one association meets five times a year; and two associations meet six times a year.

*b. Length of Meetings.*—Eleven of the twenty-two associations which hold an annual meeting meet for one day; six of these associations

have meetings of two days duration; five of these associations meet for one-half day. The other ten associations which hold from two to six meetings per year, hold these meetings for varying times from two hours to one day.

TABLE II

MEETINGS OF STATE PHYSICAL EDUCATION ASSOCIATIONS

| State | Number of Meetings | Length | Time of year of Annual Meeting | District Meetings | No. of Districts | No. of District Meetings |
|---|---|---|---|---|---|---|
| Alabama | 1 | 1 day | Spring | no | | |
| California | 1 | 1 day | Spring | yes | 2 | 1 |
| Colorado | 1 | | Fall | yes | | 1 |
| Connecticut | 2 | 1 day | Winter | no | | |
| Georgia | 1 | 2 days | Spring | no | | |
| Illinois | 1 | 1 day | Fall | yes | 5 | 1 |
| Indiana | 2 | ½ day | Fall and Spring | no | | 1 |
| Iowa | 1 | 2 days | Fall | yes | 6 | |
| Kansas | 1 | | Fall | no | | 2 |
| Kentucky | 6 | 2 hrs. | Spring | yes | | |
| Maine | 1 | ½ day | Fall | no | | |
| Maryland | 5 | 2 days | Fall | no | | 1 |
| Michigan | 2 | 1 day | Spring | yes | 9 | |
| Minnesota | 1 | 1 day | Fall | yes | 9 | 1 |
| Missouri | 1 | ½ day | Fall | no | | |
| Nebraska | 1 | 2 hrs. | Fall | yes | 6 | 1 |
| New Hampshire. | 1 | ½ day | Fall | no | | |
| New Jersey | 3 | 1 day | Fall | yes | 3 | 2 |
| New York | 1 | 1 day | Fall | yes | 7 | 3 |
| N. Carolina | 1 | 2 hrs. | Spring | yes | 4 | 1 |
| N. Dakota | 1 | ½ day | Fall | no | | |
| Ohio | 1 | 1 day | Spring | yes | 6 | 1 |
| Oklahoma | 1 | 1 day | Winter | no | | |
| Oregon | 6 | 1 day | | yes | 2 | 3 |
| Pennsylvania | 1 | 2 days | Winter | yes | 8 | 1 |
| Rhode Island | 4 | 2 days | Fall | no | | |
| S. Carolina | 3 | 2 days | | no | | |
| S. Dakota | 1 | 2½ days | | no | | |
| Texas | 1 | ½ day | | no | | |
| Utah | 4 | ½ day | | no | | |
| Virginia | 1 | 1 day | Fall | no | | |
| Wisconsin | 1 | 1 day | Fall | no | | |

*c. Time of Year.*—Of the thirty-two associations analyzed, twenty hold their meetings in the fall, seven in the spring, and three associations did not reply. Of the twenty-two associations holding an annual meeting only, sixteen associations met in the fall, five associations in the spring, and one association in the winter.

*d. District Meetings.*—Of these thirty-two associations, fourteen hold district meetings in addition to the general state meetings and

eighteen do not hold any district meetings. Ten districts of these fourteen meet once during the year, two meet twice, and two associations meet three times a year in districts. Ten of the twenty-two associations, holding annual meetings only, have district meetings; twelve of these twenty-two associations do not hold any district meetings.

*e. Special Meetings for Elementary and Secondary Schools.*—Seven of the thirty-two associations report special meetings for elementary and secondary physical education teachers. These however are group meetings within the general meeting and are not held at a separate time.

*f. Connection with the State Education Association.*—Seven of the thirty-two associations report that the state physical education association and the physical education section of the state teachers' association are one and the same organization; fourteen associations report that their state education association has no physical education section; five states report that their state does have such a section; and six associations did not reply to this question.

Seventeen associations including the seven which function as the physical education section of the state education association hold their meetings at the same time as the state education association. The same plan applies to the district meetings. The state physical education association holds district meetings to coincide with the district meetings of the state education association.

To the question "would you recommend that the two organizations (the State Physical Education Association and the physical education section of the state teachers' association) unite and function as one?" sixteen replies were received. Twelve answered in the affirmative and four in the negative. Those replying in the affirmative felt that since the purpose of the two organizations was identical that there was no need for two organizations; that both organizations drew from the same group, namely, the physical education teachers, for their membership. Those replying in the negative felt that the state education association group was largely made up of women teachers only and that their interests were too limited; that required state education association dues would deter some from joining; and that the present organization would lose its indentity in the larger state education association.

The New York Physical Education Association [7] states the case for the affirmative in a way which shows they have considered the problem from an educational point of view. They say:

"In our annual fall meetings we come together in seven geographical groups as a section of the respective districts of the State Teachers' Association. This gives us an opportunity to unite with all of our educational colleagues in the programs of the general sessions, and also to hold sectional discussions of problems in our par-

[7] H. N. McElroy, "The Health and Physical Education Association," *Physical Education Bulletin of the New York State Department of Education,* (March, 1932). P. 11.

ticular field. This arrangement helps us to view our educational purposes and problems in their true perspective. Since we are teachers, we clearly belong in the teachers' professional organization, and this affiliation is mutually helpful. Organized independently and operating under its own constitution, our association, like certain other groups, also has a distinctive status which reflects both its origin and the specialized nature of our function. It thus has its own professional problems, responsibilities, and opportunities, and with the united interest and support of its members and potential members its should grow in professional character and educational service."

Chart I shows the plan of organization of the Ohio Association. Chart II gives the California plan of organization.

CHART I

PLAN OF ORGANIZATION OF THE SCHOOL HEALTH AND PHYSICAL EDUCATION ASSOCIATION OF OHIO

Officers
elected at annual meeting.
President
Vice-President
Secretary

Representatives to the Nat'l. Council of the A. P. E. A.—The Pres. of the Ass'n.; the Secy. of the Ass'n. and one (or more) elected annually at large.

MEMBERSHIP OF THE STATE ASS'N.
Open to members of the Ohio Education Association; Staff Members of colleges and universities and health and recreation organizations.

State Council
Elected at the annual meeting. Composed of: Officers of the Ass'n.; Presidents of Sections; State Supervisor; Commissioner Athletic Ass'n.; three members at large.

One representative to the Council of the Mid-West P. E. A. elected annually at large.

DISTRICT AND PROFESSIONAL SECTIONS

| N. Eastern Ohio Teachers' Ass'n. H. & P. E. Sections | N. Western Ohio Teachers' Ass'n. H. & P. E. Sections | Central Ohio Teachers' Ass'n. H. & P. E. Sections | Eastern Ohio Teachers' Ass'n. H. & P. E. Sections | S. Eastern Ohio Teachers' Ass'n. H. & P. E. Sections | S. Western Ohio Teachers' Ass'n. H. & P. E. Sections |
|---|---|---|---|---|---|

## THE ACTIVITIES OF STATE PHYSICAL EDUCATION ASSOCIATIONS

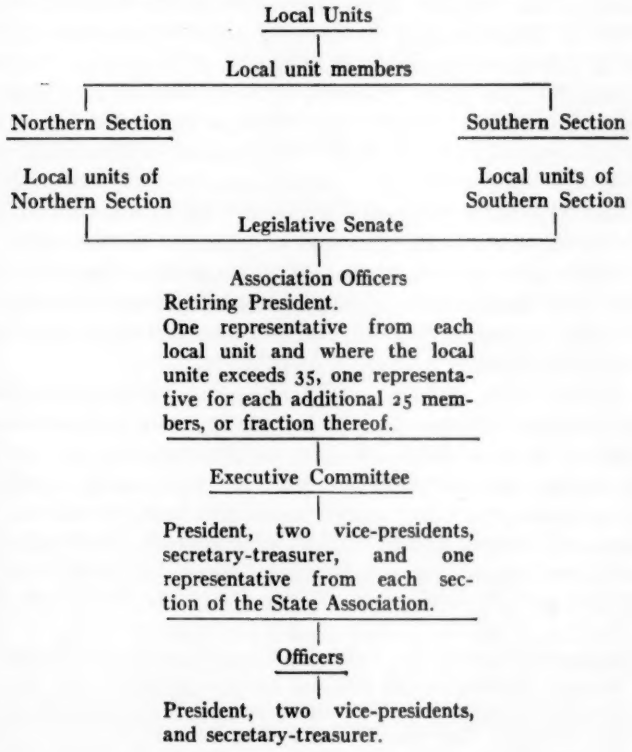
The activities of state physical education associations are analyzed in the present portion of the article under the following headings: the state meeting, publicity, publications, research studies, and legislation.

### THE STATE MEETING

A study of the program of the state meetings of twenty-two associations reveals five distinct types of activities carried on at these an-

CHART II

PLAN OF ORGANIZATION FOR THE CALIFORNIA ASSOCIATION OF HEALTH, PHYSICAL EDUCATION, AND RECREATION.




nual meetings. These activities are (1) the general session, (2) separate round-table discussions for men and for women, (3) demonstrations of physical education activities, (4) business meeting, and (5) social activities. These types of activity will be discussed in this order.

(1) *The General Session.*—All of the associations hold one large general session some time during the annual conference. This meeting

is attended by both men and women physical education teachers of all grades and types of schools. When the annual meeting is held in conjunction with the state teachers' association, the principal speaker on the physical education program is usually scheduled to speak at a general meeting of the entire teachers' association, so that in this case also the group includes a much more varied audience with the grade teachers, high school teachers, school principals, and superintendents, and in some cases the general public in attendance. Since in both of these instances the group is a heterogeneous one, it follows that the subject of the address must be such as will be broad enough to include the varied interests and capacities of the group for understanding and yet be so specific as to bring to the assembly enlightenment and inspiration.

A study of the subjects of the addresses of the associations shows that thirty-six addresses had to do with practical physical education problems in a broad sense, such as "Physical Education in the Schools of Maryland," "The Rural Problem," "What Our State Department is Doing in the Field of Health and Physical Education," and "How Physical Educators Can Serve Their Communities in Time of Economic Depression and Unemployment." Eight associations report addresses on "Modern Trends in Physical Education." Eight associations report addresses on the theory and principles of physical education. Six associations report talks on the relation of physical education and general education. Two associations report subjects on general education only, one association on mental hygiene, and four associations on the program of the American Physical Education Association.

(2) *Round-Table Discussions.*—These group meetings are held for a varying number of groups depending upon the size of their membership. In a majority of cases there are three groups specified, one on men's athletics, one on women's athletics, with the two coming together for meetings on health and other special topics which are of interest to all. In the men's or coaches' group, the following subjects are reported:

Planning the Physical Education Periods for Boys; Intramural Program for Boys; Football and Its Relation to Physical Education; High School Athletic Associations.

In the women's group the following discussions were typical:

The Women's Division of the National Amateur Athletic Federation; Planning the Physical Education Periods for Girls; Dancing in the High School Physical Education Program; High School Point System for Girls.

In the combined professional group the discussions were on such subjects as the following:

A Classifying and Grading System for Physical Education; Color Blindness in Children; Individual Gymnastics; The New York State Physical Efficiency Test and Practical Demonstration of How to Conduct the Test; Athletes' Foot.

(3) *Demonstration.*—Practically all of the meetings include at one time or another, demonstrations of the practical aspect of physical educa-

tion activities. These are usually provided by the school groups of the community in which the annual meeting is held. These demonstrations are of a very varied nature including games and stunts, tumbling, tap dancing, swimming, creative dances and rhythms, boxing, motion pictures on phases of physical education, folk dances, and the like. Following the demonstrations in a number of cases the activities are analyzed by an instructor and the definite technique of teaching the activities is shown. This practical program as reported from the state associations also lists demonstrations of rural school physical education programs and the organization of large class groups.

(4) *Business Meeting.*—The business meeting in some instances is held as a separate meeting, but in most instances is a part of the program at a noonday luncheon or precedes a general sessions meeting. The customary business of election of officers, plans for the next meeting, discussion of policies, and passing of legislation is carried on. Since in most of the associations the executive committee or legislative council functions between annual meetings and has considerable governing power, a comparatively small amount of time needs to be set aside for the business meeting.

(5) *Social Activities.*—A luncheon or banquet are the only activities of a social nature mentioned under this heading, as a part of annual meetings. In associations which hold more than one meeting or district meetings, parties and outings are sometimes scheduled as a part of the regular activity.

## PUBLICATIONS

Twenty associations report that they publish a news letter or periodic bulletin which is sent to their members. These publications range from a one-page mimeographed notice of meetings to a printed pamphlet replete with news of state-wide interest.

Special items which are included in the state news letters and bulletins are as follows: names of officers and committees, information about the association with a plea for membership, notice of annual meetings, reports of special studies and information about the American Physical Education Association and its districts, articles on health and physical education, book reviews, etc.

Five associations report that in place of a publication of their own, they work through the education association by publishing articles frequently in the magazine of the state education association. One association, Ohio, reports that an Editorial Committee stimulates the production of articles on health and physical education throughout the state and aims to have six articles a year appear in Ohio school periodicals. Two states report that one issue of the state education association monthly is devoted to physical education entirely.

It appears that while a few state associations make excellent provision for the publishing of physical education news, the majority of the associations do very little of an educational nature along this line. A publication offers a splendid opportunity for more than a mere

TABLE III
ACTIVITIES OF STATE PHYSICAL EDUCATION ASSOCIATIONS

| | News letter or bulletins | Legislation pending | Research | Special Publicity |
|---|---|---|---|---|
| Alabama | | | * | * |
| California | * | | | * |
| Colorado | | | | * |
| Connecticut | | | | * |
| Georgia | * | * | * | * |
| Illinois | * | | | * |
| Indiana | | | | * |
| Iowa | * | * | * | * |
| Kansas | * | * | | |
| Kentucky | * | | | * |
| Maine | * | * | | |
| Maryland | * | | | * |
| Michigan | * | | * | * |
| Missouri | * | | * | * |
| Nebraska | * | | | |
| New Hampshire | * | | | |
| New Jersey | * | | | |
| New York | * | | | * |
| North Carolina | | | | * |
| North Dakota | * | | | |
| Ohio | * | * | | * |
| Oklahoma | * | * | | * |
| Oregon | * | | | |
| Pennsylvania | * | | | |
| Rhode Island | * | | | |
| South Carolina | | | | * |
| South Dakota | * | | | |
| Texas | * | * | | |
| Utah | * | | | |
| Virginia | * | | | * |
| Wisconsin | * | * | | |

announcement of meetings or appeals to join the organization. It is likely that both of these objectives would be more fully realized if the material sent out contained more suggestions of the type of work the association was attempting to promote, in an effort to realize its aims and objectives.

### PUBLICITY

From the reports of state associations very little is being done along the line of promotion or publicity work to bring before the general public

and the teachers and school administrators outside the physical education fields, the physical education program. Most of the publicity work reported is carried on by means of the news letters which reach only physical education people in most cases. A few depend entirely on newspaper articles and announcements at the time of the annual meeting. A few associations work through the state education association.

It would seem that the objectives mentioned by the majority of associations "to disseminate knowledge in regard to physical education program," and "to secure an adequate state program" would be materially furthered by a more widespread and intensive publicity program. In states where legislation is needed, either for a law requiring a physical education program, provision for state director, or other reasons, the general voting public must be reached if any results are to be hoped for from this quarter.

### RESEARCH STUDIES

Only five state associations report that special studies and surveys are being conducted. These studies are concerned mostly with conditions in the state, as they should be.

The Alabama Association reports that a committee is studying the matter of standards for health and physical education in the high schools of the state. A program of physical education for senior high school boys is also being prepared.

The Georgia Association conducted a survey of the basketball situation in the state, and in addition compiled a list of all part- or full-time teachers of physical education in 1930.

The Iowa Association is preparing to issue a physical education syllabus, and has a committee to prepare a plan to raise the standards of physical education in the schools throughout the state.

The Michigan Association has made a survey of the intramural program in the public schools of its state.

The Missouri Association has made a study of standard gymnasiums and their equipment.

These are excellent contributions to physical education as far as they go, but it would seem that every state association worthy of the name should be interested in making a systematic and thorough study of conditions within the state in order to be able to recommend and promote a program of physical education best fitted to the local need.

### LEGISLATION

Thirty-six states now have a compulsory physical education law providing for the teaching of physical education in the schools of the state. The state associations have been active in promoting this legislation, also in securing the services of a state director wherever possible.

Since less than one-half of the states have a state director of physical

education an effort to make provision for one would seem to be a very logical step for state associations to take. Such efforts also provide an opportunity for bringing physical education to the attention of the community.

## CONCLUSIONS

With the rapid growth of the physical education movement in this country within the last ten or fifteen years, it is obvious that teachers of physical education have felt the need of an organization by means of which their united efforts would carry more weight in promoting state-wide programs of physical education. The fact that thirty-eight such associations are now in existence speaks well for the promptness with which the idea of group action has been put into effect.

The plan of organization in all of the state associations studied is clearly defined. Very definite duties are assigned to officers, committees, and executive councils. Plans for meetings, sections, and membership are worked out in detail. There is a growing tendency for the state physical education association to function as the physical education section of the State Teachers' Association, or in case it is not a part of that organization, to meet at the same time and in the same place as the State Teachers' Association. This appears to be, in a large number of cases, a very successful plan.

The annual meeting of the state physical education associations provides an all-round opportunity, in the majority of associations, for the members to obtain considerable benefit from a practical, theoretical, educational, and inspirational standpoint. The program in the majority of cases is well balanced and planned with foresight and good judgment.

It is easily understood that in associations recently organized the first concern is for the machinery of the organization and the increase in membership. However, if the association is to be a force in the educational field a definite program of objectives must be formed very soon after or along with the first plans of organization. A few state associations do formulate these immediate objectives as well as a more general aim and purpose. However, the majority of associations, while they have a purpose, have not definitely worked out specific objectives. Consequently a large number are not carrying on definite activities from year to year. With increased activities and interests in the field of health, physical education, and recreation the necessity for clearly defined objectives is essential if the state physical education association is to achieve constructive results.

Very few associations report any research or special studies undertaken. Much however remains to be provided for in the field of publicity and publications, research, and legislative program. While a few associations are doing outstanding work along these lines, many associations

are doing nothing and seemingly making no plans for such projects in the future. A large and valuable field of interest is being neglected which, if put into motion by a definite program, would undoubtedly make a great contribution to health and physical education.

Each association should critically determine the field in which it can perform the greatest service and then plan the specific steps which must be taken in order to bring about the desired results.

Many associations have been able to attain worthy ends which were foreseen and planned for, along the line of the promotion of legislation for physical education in the state construction of programs of physical education adopted by the State Department of Education, control of interscholastic athletics, and the like. There is reason to believe that every state physical education association can be a real force within the state and can make a valuable contribution to physical education as well as to society.

## PROPOSED PLAN FOR THE UTAH PHYSICAL EDUCATION ASSOCIATION

The following plan is suggested for the Utah Physical Education Association with the hope that it may be helpful to those who are at present concerned with the formulation of a new plan of organization which will be better suited to local conditions than those followed in the past.

From a study of thirty-two state physical education associations an attempt has been made to adapt the best practices now in vogue to a plan of organization for the local association in Utah. Many state organizations in states which are thickly populated have a complex and highly organized form of organization. Naturally these would not be applicable to the state of Utah where great distances between towns make small unit meetings impossible. The following constitution shows the plan of organization which seems most feasible for this state, at the present time.

### SUGGESTED CONSTITUTION FOR THE UTAH PHYSICAL EDUCATION ASSOCIATION

#### *Article I. Name*

The name of this organization shall be the Utah Health and Physical Education Association.

#### *Article II. Purpose*

The objects of this association shall be to awaken a wide and intelligent interest in physical education; to acquire and disseminate knowledge concerning it; to provide such state-wide physical education as will provide well-trained teachers and secure an adequate state program.

#### *Article III. Membership*

Anyone actively interested in the purpose of this association may become a member upon payment of dues.

*Article IV. Officers*

The officers of this association shall be a President, Vice-President, and Secretary-Treasurer.

They shall hold office for one year or until their successors are elected.

*Article V. Executive Committee*

The executive committee shall consist of the officers of the association, the past president, and two additional members elected to serve for a term of one year. The executive committee shall conduct all the business of the association between meetings.

(Since no district units are provided for in the Utah Association, there is no need for a Legislative Council, which is usually a device to provide for district representation.)

*Article VI. Amendments*

*Section 1.*—Amendments shall be presented in writing to the secretary-treasurer, who in turn shall present them to the members one month in advance of the time of the annual meeting when such amendments shall be voted upon.

*Section 2.*—An affirmative vote of two-thirds of the members present shall be necessary for the adoption of proposed amendments.

BY-LAWS

*Article I.*

*President.*—The president shall preside at the annual meeting and act as chairman of the executive committee.

*Vice-President.*—The vice-president shall act for the president in his absence.

*Secretary-Treasurer.*—The secretary-treasurer shall keep all records of meetings, make necessary reports and collect membership dues, keep an accurate record of the finances of the association, and make disbursements upon the approval of the executive committee.

*Article II. Dues*

*Section 1.*—The annual dues for membership in the Utah Association shall be one dollar.

*Section 2.*—Upon payment of an additional two dollars, membership may be had in the American Physical Education Association. This membership includes a subscription to the *Journal of Health and Physical Education.*

*Article III. Meetings*

The association shall hold an annual meeting every year at the time of the Utah Education Association Convention.

*Article IV. Committees*

All standing and special committees shall be appointed by the Executive Committee.

*Article V. Changes in the By-Laws*

These by-laws may be changed by a two-thirds vote of the members of the association present at the annual meeting.

ADDITIONAL SUGGESTIONS FOR REORGANIZATION

*I. Relation with the Utah Education Association.*—Since there is at present a physical education section of the Utah Education Association it would seem, if the best interests of physical education in the state are to be served, that a definite relationship should be worked out with

this organization in order to avoid duplication of effort in the physical education field, as well as confusion in the minds of the people outside this field as to the nature of these two organizations.

It is therefore recommended that the Utah Physical Education Association affiliate with the Utah Education Association, in order to function as the physical education section of that organization; that the officers and committees of the state association be the same as those of the section; that the annual meeting of the Physical Education Association be held at the same time and as a part of the Utah Education Association.

*II. Objectives.*—It is suggested that as soon as the association completes its reorganization plans, definite objectives be outlined and passed upon at the annual meeting. It is further suggested that during the first year especially that these objectives take the form of a survey or research study of physical education within the state and that a complete knowledge of existing conditions shall be determined before action is taken to promote any particular plan. The following suggestions for such studies are not meant to be exhaustive, but are merely mentioned to illustrate the preceding point:

1. A study to determine the need and desirability of taking steps to secure the appointment of a state director of physical education, which office is already provided for by law.
2. A survey of the high school physical education program of the state, for boys and girls.
3. A similar survey of elementary schools.
4. A study of the professional preparation of physical education teachers within the public school system of the state.
5. A survey to determine to what extent physical education is being taught by teachers who have had no training in this subject; also to what extent teachers trained in physical education are teaching other subjects, or a combination of physical education and other school subjects.
6. A study to determine how physical education is accredited in the high schools of the state.
7. A study of the interscholastic athletic situation within the high schools of the state, in regard to both boys' and girls' athletics.

*III. News Letter.*—It is suggested that plans for a periodic news letter be made, and that these plans be put into action as soon as the financial status of the association makes it possible. If the association holds only an annual meeting a news letter is almost essential for keeping members interested and informed.

*IV. Promotion.*—Definite publicity work should be planned as soon as the association becomes established. This should not merely take the form of publicity and information to association members, but a well worked-out plan should be made by a special committee to make opportunities to bring the association and the physical education program to the attention of school administrators, the teachers, and the

general public. This committee could also be responsible for making contacts with other educational organizations.

## APPENDIX

### SUMMARY OF THE STATE PHYSICAL EDUCATION ASSOCIATIONS

*Alabama.*—The Alabama Physical Education Association was organized in 1926 and reports a membership of 150.* This association holds an annual meeting in the spring in connection with the Alabama Education Association. This is the only meeting of the year, no district meetings being held. This association functions as the physical education section of the Alabama Education Association.

The association works through three groups, a Woman's Section, a Men's Section, and a Joint Section. The first two are subdivided into three groups, namely (1) Teachers' Training, including University, Normal School, and Church Schools, (2) High Schools, and (3) Elementary Schools. The joint section is concerned with health problems of interest to both groups, outings, and social activities. A membership committee and a round-table discussion group for teacher trainers and county supervisors, together with the association officers make up the administrative force of the organization. The Alabama association is represented in the Legislative Council of the A. P. E. A.

*California.*—The California Association of Health, Physical Education, and Recreation was organized in 1930 and has one thousand members. Contrary to usual custom the local units were organized first, then the section, and then the state. The state organization is loosely organized purposely, its business being carried on by what is termed a "Legislative Senate." The sections coincide with sections of the California Teachers Association and meet in connection with, and as a part of, that body. These meetings are held annually in connection with the Teachers' Institutes. The local units meet more often, monthly or bi-monthly. These meetings are of a social and professional nature. The dues collected support all segments of the state organization, for example—state, section (California has two sections, north and south), and local. The state receives ten cents per member, the section twenty-five cents per member, and the balance, not to exceed one dollar, goes to the local unit.

*Colorado.*—The Colorado Physical Education Association was organized in 1931 and reports a membership of eighty members. It holds an annual meeting in the fall with the district meetings throughout the year. This association is not a part of the state teachers' association but cooperates with it. A news letter is sent to members periodically and other and more extensive types of publicity are being planned. This association is one of the more recent to be organized. It is represented on the Legislative Council of the A. P. E. A.

*Connecticut.*—The Connecticut Physical Education Society was organized in 1920 and reports eighty members. Membership is open to anyone interested in physical education. This association holds two meetings per year of one day each. Its publicity work consists of newspaper articles only at the time of the two meetings. This association is represented on the Legislative Council of the American Physical Education Association.

*Georgia.*—The Georgia Physical Education Association was organized in 1921 and while it does not report as large a membership as some associations (fifty-eight members reported), the program of the organization seems to be very well organized. A news letter from the president goes to the members at regular intervals. A very splendid report of the annual meeting is published with a brief résumé of all the addresses and activities and with a list of members, committees, officers, objectives for the year, and a list of suggested books for the physical educa-

*All membership figures listed are of the year 1930–31.

tion library. This association has five articles on physical education subjects printed in the magazine of the state teachers association, has been instrumental in having a compulsory physical education law passed, and engages in special studies and research problems.

*Illinois.*—The Illinois State Physical Education Association is one of the newer ones to be organized (1931) and is still completing plans for organization. This association meets annually at the time of the Illinois High School Conference. The constitution provides for divisions of the state association, with divisional meetings suggested in conjunction with the divisional meetings of the state teachers' association. Considerable freedom is given the local units in regard to time and number of meetings. The state association is governed by a state executive council. The Illinois Association is represented in the Legislative Council of the American Physical Education Association.

*Indiana.*—The Indiana Association of Physical Education holds two meetings during the school year, one in the fall and the other in the spring. The fall meeting is held in conjunction with the State Teachers' Association and the association is a section of that organization. This association places considerable governing power in the hands of the Executive Board. The Indiana association has seventy members and is represented in the Legislative Council of the American Physical Educational Association.

*Iowa.*—The Iowa Physical Education Association was organized in 1921 and reports 150 members for 1930-31. The association holds an annual meeting in the fall in connection with the State Teachers' Association. The government of the organization is vested in a State Council which manages all the affairs of the association. A very fine news letter is sent to members monthly which carries considerable news of what the association is doing. This association is engaged in promoting legislation in the interests of physical education program and has had also published a *Syllabus* for a state physical education program. This organization is a member of the Legislative Council of the American Physical Education Association.

*Kansas.*—The Kansas State Health and Physical Education Association was organized in 1929 and has fifty members. The government of the association is vested in a Council. This association holds an annual meeting in November which is built around various round-table groups. The chairman of these round-tables are members of the Council. The annual meeting is held at the same time as that of the State Teachers' Association. The Kansas association publishes and sends out to members a periodic news bulletin. It is a member of the Legislative Council of the American Physical Education Association.

*Kentucky.*—The Kentucky Health and Physical Education Association was organized in 1924, and reorganized in 1929. It reports a total of sixty-five members. This association holds six meetings a year of two hours each, with from one to three district meetings a year. Part of its publicity work is done through the magazine of the State Teachers' Association. Kentucky is represented in the Legislative Council of the American Physical Education Association.

*Maine.*—The Maine Society of Health and Physical Education was organized in 1931 and holds an annual meeting in the fall. This association functions as the physical education section of the State Teachers' Association. The Maine association has started a movement to secure a state director of physical education. The program of the annual meeting is well balanced with general education subjects, demonstrations, and physical education topics for discussion. This association publishes a periodic news bulletin and is a member of the Legislative Council of the American Physical Education Association.

*Maryland.*—The Maryland Physical Education Association was formerly the Baltimore Physical Education Society, organized in 1920. In 1930 the organization became state-wide and changed its name to the present one. This association reports a membership of 132. This association does not meet in conjunction with

the State Teachers' Association and does not favor such a procedure. Five meetings per year are held with the usual addresses and demonstrations. Mention is made also in the report of this association of meetings of a social nature. The Maryland association publishes an excellent printed monthly news letter which contains a considerable number of items of general interest, such as reports of interscholastic tournaments and athletic meets.

*Michigan.*—The Michigan Physical Education Association was established in 1896 and reports a membership of six hundred. Two state meetings are held each year and nine districts hold one meeting each sometime between these meetings. This association publishes a bulletin besides sending out letters to members at various times. A survey of the intramural program of athletics in the state is now being conducted as a special project of the association. The Michigan association is represented in the Legislative Council of the American Physical Education Association.

*Minnesota.*—The Council is the executive body of the Minnesota Physical Education Association and its sixteen members are made up of the officers of the state association and representatives of the local groups, of which there are nine. The association holds an annual meeting the time of which is decided by the Council. A suggested plan for section meetings is sent out to the districts with additional suggestions for committees and study programs. The Minnesota association is represented on the Legislative Council of the American Physical Education Association.

*Missouri.*—The Missouri State Physical Education Association was organized in 1929 and has 115 members, at the present time. It holds an annual meeting in the fall of one-half day in length. The publicity work of the association is carried out through the state department of education, in addition to the publication of a periodic news bulletin. A study on standard gymnasiums and equipment has been a special project of this association. The Missouri Association is a member of the Legislative Council of the American Physical Education Association.

*Nebraska.*—The Nebraska State Physical Education Association was very recently organized (October, 1931) and therefore has not completely formulated its plans for organization and program. It provides for an annual meeting in the fall, at the same time as the meeting of the Nebraska Teachers' Association, with regular sectional meetings in six districts of the State Teachers' Association. The government of this association is vested in the Council, which is authorized to conduct the business of the association. The Nebraska association is represented on the Legislative Council of the American Physical Education Association.

*New Hampshire.*—The New Hampshire Physical Education Association was organized in 1927 and has thirty-one members. An annual meeting is held in the fall of each year and a spring meeting is under consideration. The government of the association is vested in a Board of Directors. A news letter is sent out by the president from time to time. This is a mimeographed bulletin which contains articles of interest to physical education teachers, as well as news items and a book list.

*New Jersey.*—The New Jersey Physical Education Association was organized in 1919 and reports 360 members. This association holds three meetings a year, with three districts holding two meetings each. A very fine type of meeting is planned by this association with addresses by leaders in the field of general education as well as in physical education. Considerable power is given by the constitution to the Council which has power to govern between meetings.

This association publishes a sixteen-page printed news letter which contains a résumé of the addresses and activities of the regular meetings, book lists, articles on physical education, as well as the customary notices of meetings. The New Jersey association is a member of the Legislative Council of the American Physical Education Association.

*New York.*—The New York Health and Physical Education Association was

first organized in 1912 and then reorganized in 1924. This is one of the largest associations with a membership of 834. This association functions as the physical education section of the State Teachers' Association but has its own constitution and organization. It holds an annual meeting in each district and from two to four other district meetings, the number varying in different districts. The state is divided into seven districts.

The New York association carries on its publicity work by means of letters to members, newspaper articles, and announcements, and one issue of the *Bulletin of the State Department of Education*, which for one issue is devoted entirely to physical education and is edited by the officers of the State Physical Education Association. The New York association is represented on the Legislative Council of the American Physical Education Association.

*North Carolina.*—The North Carolina Physical Education Association was organized in 1921 and reports that its membership is very small. The association holds an annual meeting in March which is the section meeting of the North Carolina Education Association. Four district meetings are held during the year. The only publicity work is carried out through the State Teachers' Association and consists mostly of speakers on the annual convention program.

*North Dakota.*—The State Physical Education Association of North Dakota was organized in 1927. This association holds an annual meeting in the fall of one-half day in length. The only activity reported is the annual meeting which consists of addresses and demonstrations of physical education topics.

*Ohio.*—The Ohio School Health and Physical Education Association was organized in 1928, and reports an organization of twenty-five hundred members. An annual meeting is held in the spring with six district meetings during the year. Each district holds one meeting. The government of the association is vested in a state council which is authorized to effect such organization as is necessary to conduct the business of the association. A periodic news letter is sent out by the state director of physical education. The Ohio association is represented on the Legislative Council of the American Physical Education Association.

*Oklahoma.*—The Oklahoma State Physical Education Association was organized in 1924 and reports a membership of eighty-three. The association holds an annual meeting in February of one day in length, at the time of the State Teachers' Association convention. A news letter is published, but no special studies or activities are reported except the annual meeting. The Oklahoma association is represented on the Legislative Council of the American Physical Education Association.

*Oregon.*—The Oregon State Physical Education Association was organized about 1921, the exact date not being known. An approximate membership of eighty-seven is reported. This association holds six meetings a year of varying lengths. Physical education subjects almost entirely make up the program for the regular meetings. No other activity is reported. The Oregon association is a member of the Legislative Council of the American Physical Education Association.

*Pennsylvania.*—The Pennsylvania State Physical Education Association was organized in 1923, and has 130 members. An annual meeting is held in December with eight districts holding one meeting at some other time during the year. The State Director of Physical Education is the secretary-treasurer of the organization. This organization is represented on the Legislative Council of the American Physical Education Association.

*Rhode Island.*—The Rhode Island Physical Education Association was organized in 1924 and has one hundred members. Four meetings are held during the year of two hours each. No activity other than these regular meetings is reported by this association.

*South Carolina.*—The South Carolina State Physical Education Association was organized in 1928 and has a membership of forty. Three meetings are held

during the year of two hours each. No district meetings are held and no publicity or research studies are reported.

*South Dakota.*—The South Dakota Health and Physical Education Association was organized in 1931 and is one of the newest associations. It provides for an annual meeting in the fall of two days in length, at the time of the South Dakota Education Association meeting. This association functions as the physical education section of that organization. The association is planning to do part of its publicity work through the journal of the state teachers' organization. The government is vested in an executive committee.

*Texas.*—The Texas State Physical Education Association was organized in 1923 and has a membership of 150. An annual meeting is held in the fall of two days' length. This association reports that all of its members are also members of the State Education Association for which they pay extra dues. A monthly news bulletin is published and sent to members. The Texas association reports that it was responsible for the passage of a compulsory physical education law in the state. This association is represented on the Legislative Council of the American Physical Education Association.

*Utah.*—The Utah Physical Education Association was organized in the summer of 1908, as nearly as can be ascertained, under the leadership of Professor Jacob Bolin and Professor Maud Mae Babcock, both of the University of Utah. The organization functioned actively for approximately fifteen years and was affiliated with the American Physical Education Association by representation on the Legislative Council of the national association. Toward the end of this time interest waned and for several years no meetings were held, but in the spring of 1931 plans for reorganization were begun. A new constitution has been proposed and various plans for continuing this organization are being studied. The new form of organization was determined at a meeting in the fall of 1932.

*Virginia.*—The Virginia Health and Physical Education Association was organized in 1925 and reports a membership of 150. An annual meeting is held in the fall but no district meetings are held. This association plans its publicity work in connection with that of the state teachers organization. It reports a curriculum study committee. The Virginia association is represented on the Legislative Council of the American Physical Education Association.

*Wisconsin.*—The Wisconsin Physical Education Society was organized in 1916 and has a membership of 150. Its government is vested in the executive committee which has the power to carry on business between annual meetings. It holds an annual meeting at the time and place of the Wisconsin Teachers' Association convention. The officers and program of the physical education section of the teachers organization are the same as those for the State Physical Education Association. The two groups function as one organization. This association publishes quarterly bulletins. A committee to promote plans for securing a state supervisor of physical education is reported. The Wisconsin association is a member of the Legislative Council of the American Physical Education Association.

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# BOOK REVIEWS

SAFETY IN PHYSICAL EDUCATION IN SECONDARY SCHOOLS. Frank S. Lloyd. (National Bureau of Casualty and Surety Underwriters, 1933) 167 pages. $1.25.

This book on safety is a careful analysis of safety procedure in secondary schools. The scope of the study includes a two-fold problem, (1) the prevalence and nature of accidents, (2) the factors that may be considered contributory to their incidence.

Dr. Lloyd's study is the first ever made nationally and is of vital importance to all teachers of physical education in secondary schools. The scope is broad enough so that the conclusions reached may be considered as valid. Nine hundred fifty-eight schools representing 20 states were sent supplies. Five hundred ten schools reported accidents. These 510 schools represent 593,436 students or about 14 per cent of all students enrolled in public and private high schools in the United States.

The book is replete with tables dealing with gross incidence of accidents; incidence by activities; nature of injuries and parts of the body affected; types of hazard; stated causes of accidents by activities; and contributing factors. That these various phases are adequately covered is shown by the check list sent to the schools dealing with:

1. Time
2. Seasons
3. Equipment
4. Nature of injury
5. Time lost
6. Place of accident
7. Nature of situation
8. Activity
9. Sex
10. Age and grade
11. Part of body injured
12. Leadership
13. Causal factors

The chapter on the legal protection of the student and the school, dealing as it does with the legal and moral responsibility of the school and with the problem of insurance for students, is of particular interest and value. The physical educator will also be particularly interested in one conclusion reached, namely, "Schools not having a full time teacher of physical education tend to show a higher accident incidence than those with a full time teacher." Other conclusions reached that are of vital import to the physical educator are that, "approximately 50 per cent of accidents are attributable to inadequate equipment and leadership control"; "interscholastic competition is more hazardous than intramural class instruction or 'free play'"; "physical examinations are contributing to a low incidence"; "to have a clinic available when accidents occur does not tend to lower the days lost incidence, but a hospital in the vicinity does."

The author's contention that safety must be made a student responsibility is an educational challenge that the physical educator must accept. As he states, however, this must be supplemented by throwing up every safeguard possible in the way of leadership, equipment controls, wearing apparel, and program control, recognizing that physical education activities at their best contain many hazards but that it is through training students to meet hazards that the program of safety may become really educative.

V. S. BLANCHARD,
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SHAWN, THE DANCER. Katharine S. Dreier. (A. S. Barnes & Co., 1933) 81 pages. $3.00.

Any book on Shawn must necessarily be of interest to dancers the world over, as he has been and still is one of the outstanding individuals in the field of the dance. This book is unique in that Miss Dreier has preferred to show Shawn's artistry pictorially, and with the exception of a short essay the book is composed entirely of pictures of Shawn in striking poses from the dances which he has created. Opposite each picture is a brief notation on the particular dance with music references, and an appendix gives in greater detail the thoughts and ideas behind each of the illustrated dances.

In her essay on Shawn, Miss Dreier says:

"To some, the clear pure note as it floats out upon the air represents the highest achievement in music. It is the purity and clarity which enthralls. To others it is the great rhythm of life as expressed in the sea, in the rhythm which holds each star in its course . . . . As Pavlova stands for lightness and pureness of motion, as she floats through the dance, so Shawn stands for a power of rhythm which refills one with fresh vitality."

The book seems to find its keynote of rhythm in the quotation from Havelock Ellis in *The Dance of Life:*

"That is one reason why dancing, however it may at times be scorned by passing fashion, has a profound and eternal attraction even for those one might suppose farthest from its influence. The joyous beat of the feet of children, the cosmic play of a philosopher's thoughts, rise and fall according to the same laws of rhythm. If we are indifferent to the art of dancing we have failed to understand not merely the supreme manifestation of physical life, but also the supreme symbol of spiritual."

This keynote of rhythm has been further carried out by the frontispiece, painted by the author, and entitled "Abstract Psychological Portrait of Shawn" in which Shawn's emphasis of the spiral form of rhythm is clearly developed.

Beautifully bound in silver and blue, the book is a work of art and should be a striking addition to the library of the dance lover.

HELEN N. SMITH,
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GYMNASTICS, TUMBLING, PYRAMIDS. J. H. McCulloch, A.M. (W. B. Saunders Company, 1934) 177 pages. 265 illustrations. Cloth $2.00.

Professor J. H. McCulloch, in his new book, *Gymnastics, Tumbling, Pyramids,* has presented the subject in a very masterful and tactful manner. As an informal presentation of gymnastic work, it is outstanding.

Too often gymnastics are considered as strictly formal drills in mass formation. McCulloch has shown by very appropriate devices of word and illustration how stunts may be simplified; thus offering students an opportunity to develop some of the fundamental movements which, from a physiological and psychological viewpoint, should be emphasized.

By means of diagrammatic illustrations the author has made it possible for teachers and students to analyze accurately and quickly the various positions and changes of position that are so difficult to determine from photographic illustrations. Most texts on this subject make use of the latter type of illustration. It is practically impossible to obtain accurate photographs of the numerous body positions and changes of grasp on various pieces of apparatus.

It seems to me that McCulloch has answered the question, "How may gymnastic nomenclature be appropriately illustrated?"

By making apparatus and tumbling routines interesting and enjoyable, Mr. McCulloch has gone a long way toward developing good emotional attitudes toward physical activities. He has accomplished this mainly through the excellent methods used in developing the various exercises illustrated in his text.

First, the author lists the objectives of apparatus and tumbling. He then considers each piece of apparatus separately and progresses from very simple coordinations to complex and difficult routines.

Thus, through an understanding of the general objectives of gymnastics and by performing exercises that are enjoyable and that are progressively increasing in difficulty, the student's interest is aroused from the start, and is retained throughout the lesson, series of lessons, or course. This retention of interest is of vital importance in all gymnastic work.

RUSSELL K. CUTLER,
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INTRAMURAL ACTIVITIES — THEIR ORGANIZATION AND ADMINISTRATION IN THE JUNIOR AND SENIOR HIGH SCHOOL. Robert E. Lindwall. (1933) 88 pages. $1.00.

This is a very much worth-while treatment of the subject of intramural athletics in the junior and senior high schools. In advertising his work the author says: "Every man in the field of physical education *will want* a copy of this book." I should like to go a step farther and say: "Every man in the field of physical education *should have* a copy of this fine book."

Appropriately dedicated to Elmer D. Mitchell, "the father of the modern intramural movement," with a fine introduction by Guy S. Lowman of the University of Wisconsin, the book concludes with an excellent bibliography of books, articles, and other published material on intramurals. The book, in addition to being an asset to any library of books on physical education, should prove an excellent supplementary text to *Intramural Athletics* by Mitchell wherever a course in intramurals is taught at the college level.

In the words of the author, he "is trying to present what are thought to be the best practices and trends in the organization and administration of intramurals in the junior and senior high schools." This he has done well; his material and conclusions having been drawn from the results of an extensive study of some of the outstanding high school programs in the country. Intramurals are a comparatively new venture in the high schools of this country and so what has been written down in this book must of necessity be regarded as authoritative on the progress of intramurals to date. What the future holds no one can say.

The first chapter of the book deals with "Terminology," defining those terms commonly used or allied with intramurals. Nothing new is presented here, save that the author expresses a preference for the term "Intramural Supervisor" rather than "Intramural Director." This is relatively unimportant and I believe, in respect to this point, that most of us would go along with Shakespeare when he says:

"What's in a name? that which
we call a rose
By any other name would
smell as sweet."

The second chapter concerns itself with the educational values of intramurals and the material presented here is based largely on the writings of men of prominence in the field of physical education. The writings of such men as Jay B. Nash, Jesse F. Williams, and Delbert Oberteuffeur are cited as evidence of these values.

Under the title head, "Principles of Organizing and Administering the Program," the author has brought together twenty-two statements, each one of which is a definite and complete indisputable fact in itself.

A chapter entitled "Aspects of Organization and Administration" offers a scholarly discussion of the underlying principles to be followed in the organization and administration of the intramural program. Especially good is the section devoted to the classification of contestants for competitive events. Several scientific methods of classification are described and one is sure to find one of them suited to the particular needs of his own school.

The final chapter, "Practical Program 'Set-Ups,'" offers some real meat in the way of practical programs now in operation in different schools in various sections of the country. This chapter alone is well worth the price of the book.

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THE CONTROL OF FOOTBALL INJURIES. Marvin A. Stevens, M.D., and Winthrop M. Phelps, M.D. (A. S. Barnes and Company, 1933) 241 pages. $3.00.

Of all the books published relative to the control of football injuries, this one represents a worthy contribution not only to those interested in football, but to every one interested in the general realm of athletics.

This book represents a scientific treatment of the subject supported by vivid and unmistakable illustrations. The scientific investigations included at the end of the book undoubtedly will be of more constructive value perhaps than the main body of content. Undeniable facts, startling discoveries, and helpful suggestions are revealed in the scientific investigations alone.

Anyone who may chance to read this excellent book will undoubtedly admit its simple, direct, and effective ease of style. The print is large and the lines are sufficiently separated to facilitate fast reading without eyestrain. In addition, another attribute or inducement toward fast reading is its marked unity.

The scope of this work is comprehensive, in the light of present knowledge on the subject and its related field, training and conditioning. It might rightfully serve as a textbook or a helpful source of information first of all to the coach, then to the athletic trainer, to the athletic supervisor, scoutmaster, and lastly, but not of least importance, to the athlete himself.

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DANCING IN THE ELEMENTARY SCHOOLS. Committees on Dancing of the American Physical Education Association. (A. S. Barnes & Co., 1933) 134 pages. $1.00.

The field of dancing in physical education, more than any other field, needs a clearer definition of aims and objectives, a greater concept of methods of teaching, and a finer analysis of subject matter suitable to educational procedure. The market has been flooded for years with volumes of dance materials but few books have been written dealing with the theory of the dance or with methods of creative teaching. Young teachers of dancing have floundered amidst various systems, have imitated to the best of their ability their own particular instructors, and have struggled with certain of their own creative ideas. Dancing in the schools has suffered from the usual American proclivity toward faddism. It has embraced Isadora Duncan, interpretive dancing, German dancing, and so-called modern dancing. It has embellished folk art and has glorified the purely rhythmic beat of tap dancing; but what it has forgotten is that the teaching of dancing in the schools should be an educative procedure and not mere kinematics.

The book, *Dancing in the Elementary Schools*, is an attempt to study problems of the dance in relation to the elementary schools. The material presented was selected from the reports of two committees on dancing, and includes significant chapters on "Objectives for Dancing," "Methods of Teaching Dancing," "A Survey of Dance Activities and Their Basic Movements," "The Correlation of Dancing with Other Activities," "Dancing for Boys," "Rhythm," "An Analysis of Accompaniment for the Dance," "Dancing in the Major Course in Physical Education," and "Dancing in the Preparation of the Classroom Teacher."

These subjects are not complete treatises nor are they cure-alls for the field of dancing. The book, however, is an attempt to set forth the underlying principles of the dance in relation to the elementary school and to promulgate the

thought as expressed in the preface by Mary O'Donnell that: "To teach dance in a truly integrated fashion, to realize all the educative possibilities inherent in so vital an activity, requires more than recourse to ready-made materials. . . . No single contributor feels, in any sense, that the last word has been spoken. There must be a great deal of scientific experimentation in the realm of objectives, for instance, before any truly authoritative pronouncements can be made. The content of this book, frequently controversial in character, is offered with the desire to present the current opinions of persons of wide experience on that most vital problem—teaching children to dance."

It seems to the reviewer that every teacher of dancing should use this book for guiding principles and especially recommended is the excellent chapter on "Methods of Teaching Dancing" by Mary P. O'Donnell.

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The New Health Living Series. C-E. A. Winslow and Mary L. Hahn. (Charles E. Merrill Co., 1932) Revised.

THE GAME OF HEALTHY LIVING. 216 pages. 64 cents.

THE HABITS OF HEALTHY LIVING. 218 pages. 64 cents.

THE LAWS OF HEALTHY LIVING. 250 pages. 64 cents.

THE HEALTHY COMMUNITY. 266 pages. 68 cents.

The revision of this series presents four attractive books designed for use in grades five to eight. The authors have prepared material with certain accepted principles of health education in mind: (1) Health education should be positive, not negative; it should stress the splendor of health not the fear of detail, and it should avoid morbid medical detail. (2) Health education should be practical and should focus on the formation of health habits. (3) Health education should have a definite and satisfying intellectual content. It should establish sound conceptions of the human machine and its operation as a basis for the development of health habits. (4) Health education should, at all possible points, correlate with other subjects and with education in social responsibility and citizenship.

In the first book the emphasis is put on the development of the right attitude toward health. Such topics as the body, measuring growth, food, how our bodies use food, teeth, the skin, posture, exercise, safety, etc., are treated with this viewpoint in mind. The second book discusses how our bodies grow and develop, something of the mechanics of the body, food needs, how we breathe, the blood, keeping the body clean, teeth, control systems of the body, the windows of the body, and the effect of alcohol, etc., on health and efficiency.

The plan of these two books is similar. There are review questions and suggested activities at the end of each chapter. The suggested activities should help the child translate the subject matter in terms of life. Each book contains tests of the true-false, multiple choice, and completion types. The tests are good and are suggestive to the teacher. *The Laws of Healthy Living* has two features not found in the *Game of Healthy Living;* questions at the beginning of each chapter that will stimulate thought, and a glossary. Both of these are useful as teaching helps. If these books are used in successive grades, there is an interesting continuity of subject matter that avoids undesirable repetition, yet allows for necessary review. The chapters on food in the *Game of Healthy Living* may be used to illustrate the attempt at correlating with other subjects. The subject matter and the charts on p. 59 and 60 can be utilized in geography.

The third and fourth books also contain the desirable teaching helps found in the other books. There are questions at the beginning of the chapters, review questions and suggested activities at the end of the book, a glossary, as well as an index; tests for the chapters, height-weight tables, how to weigh and measure, tables of food values, a home score

card, etc., are included. The third book presents subject matter to rationalize health habits and the fourth concerns itself with problems of community hygiene.

These four books contain excellent health material which is presented in a straightforward simple style. The books are attractive; there are excellent pictures and illustrations. The authors provide for repetition which is necessary if habits are to be formed and rationalized so that they will remain for life.

It is to be regretted that so recent a series includes height-weight tables and any widespread use of "normal" weight when one considers recent investigations that have discredited the idea of normal weight. The accompanying text, however, is sound and does not overemphasize normal weight, nor is there any attempt to compute percentage over- and underweight.

This series of books is decidedly worth while and deserves the serious consideration of those who purchase books for health education.

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MODERN WRESTLING FOR THE HIGH SCHOOL AND COLLEGE. H. Otopalik. (Charles Scribner's Sons, 1930) 128 pages. 80 illustrations. $2.00.

I have read *Modern Wrestling*, by H. Otopalik, and found it a very thorough and interesting treatise of the sport. He has approached the subject from an educational viewpoint, emphasizing the physical and mental benefits; also the carry-over values of the sport.

The material is presented so that it is readily understandable by the novice, yet challenging and informative to the coach or wrestler of experience. At the outset the author gives some timely arguments for the sport which may be useful in communities where the professional phase of the game has given, to its general public, an erroneous impression of the sport as a whole. These comments should help overcome occasional parental objections, and give the sport the place it rightfully deserves in a well rounded physical education program.

The book includes ten methods of going behind an opponent, with counters for each; several methods of retaining a position of advantage, with defensive maneuvers for these holds; numerous methods of getting free and coming from underneath; and finally, an adequate number of pinning holds.

Additional features of this very complete book are supplementary contests, of the wrestling type, which may be used advantageously in group instruction in physical education classes; a very practical chart and discussion on weight reduction, discouraging the practice of sacrificing the welfare of the individual to win a team meet; a chapter on conditioning the wrestler; and a discussion of the rules of the sport.

Mr. Otopalik's long and varied experience as a teacher of wrestling gives him an excellent knowledge of the game, and his book should be found in every high school and college library. It would also be an asset to one's personal library, whether interested as a coach, participant, or spectator of the sport.

A. A. JAMES,
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THE OFFICIAL WRESTLING RECORD AND SCORE BOOK FOR COLLEGE, HIGH SCHOOL, Y. M. C. A., AND A. A. U. MEETS. H. Otopalik. (Hopkins Sporting Goods Company, 1932) 52 pages. Paper bound, 75c.

This book contains a number of very complete and well-arranged dual meet score sheets which are invaluable for recording and permanently retaining individual and team records. These blanks also provide space for signatures of officials, interesting newspaper clippings, and special comments regarding the meet.

The brackets for recording tourna-

ment winners in the preliminary, quarter-final, semi-final, and final rounds, should greatly facilitate the promotion of wrestling tournaments. The author also includes a brief summary of rules for high school, college, A. A. U., and Olympic meets.

A. A. JAMES,
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HYGIENE OF COMMUNITY, SCHOOL, AND HOME. Ernest W. Steel and Ella G. White. (Harper & Brothers, 1932) 368 pages. $2.25.

A brief historical review of the conceptions of disease is followed by an appeal for cooperation in promoting health on the basis of the economic cost of ill health, which is stated as averaging $80.00 per year for each family in the United States. This does not include the loss of income, decreased production, worry, suffering, and other significant social considerations.

A chapter on microbes, especially as they are related to man's health, prepares for the consideration of communicable diseases which are treated from the standpoint of types, symptoms, and methods of control. The noncommunicable diseases are given comparatively brief consideration.

One feature not commonly included in such a text is that of health laws and the organizations for their enforcement, including the police and health departments. One chapter is devoted to child and maternity hygiene.

Water supply, waste disposal, plumbing, municipal house-cleaning, protection against insects and animals injurious to health, receive adequate space. Safeguarding the food supply with special reference to milk is one of the most valuable sections. Twenty-one pages are given to heating, ventilating, and lighting. School, industrial, and camp hygiene have relatively minor mention, while domestic hygiene has scarcely enough space to justify its inclusion.

In make-up the book is decidedly attractive. The type is clear and well leaded, topics appear in heavy or double faced type, the quality and finish of the paper is good, illustrations, charts and diagrams add interest, and a fifteen-page index aids in readily locating topics.

The bibliographies at the end of each chapter refer to books only and references to them in the text itself are not keyed, so that their value is materially decreased. More footnotes, such as on page 75, would aid teachers in checking on original sources and securing further information.

Statement of facts are clear without employment of many technical terms, so that for a general or orientation course in college or even the senior year of high school, the text is deserving of favorable consideration.

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